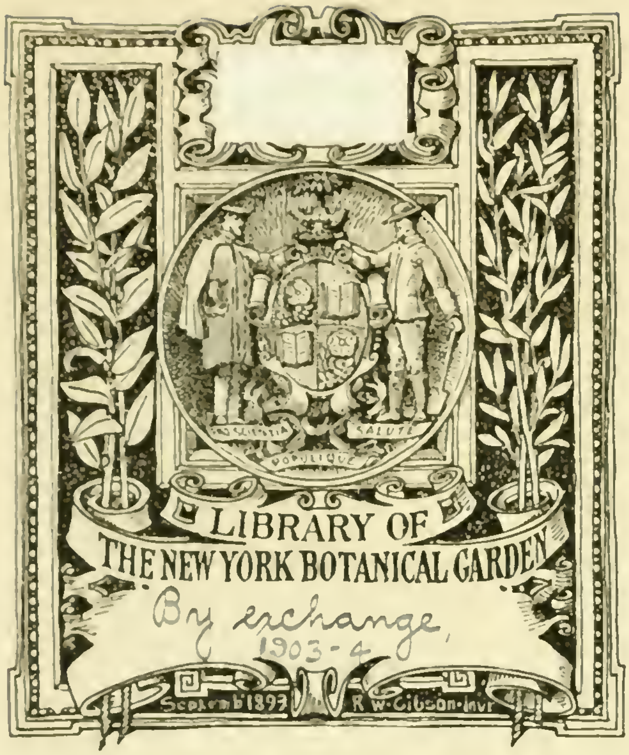
SHOUT
SHARE
IT


SCIENTIA
SALUTE
POPULIQUE
Septemb 1897
R W Gibson Invr

LIBRARY OF
THE NEW YORK BOTANICAL GARDEN
By exchange,
1903-4

CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
OF THE
LELAND STANFORD JR. UNIVERSITY

XXXI

The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California

By RALPH ARNOLD

[Reprinted from the Memoirs of the California Academy of Sciences
Vol. III]

STANFORD UNIVERSITY, CALIFORNIA
1903

Contributions from the Hopkins Laboratory.

1. **The Fishes of Sinaloa.** By David Starr Jordan. pp. 142. 29 *plates.*

2. **On the Cranial Characters of the Genus Sebastodes.** By Frank Cramer. pp. 42. 14 *plates.*

3. **The Fishes of Puget Sound.** By David S. Jordan and Edwin C. Starks. pp. 71. 29 *plates.*

4. **New Mallophaga, I,** with special reference to a Collection made from Maritime Birds of the Bay of Monterey, California. By Vernon L. Kellogg. pp. 144. 15 *plates.*

5. **Notes on Fishes, Little Known or New to Science.** By David Starr Jordan. pp. 48. 24 *plates.*

6. **Notes on Fresh Water Fishes of the Pacific Slope of North America.** By Cloudsley Rutter. **Description of a New Species of Pipe-Fish (Siphostoma sinaloæ) from Mazatlan.** By David S. Jordan and Edwin C. Starks. **Notes on Deltistes, a New Genus of Catostomoid Fishes.** By Alvin Seale. pp. 29.

7. **New Mallophaga, II,** from Land Birds, together with an account of the Mallophagous Mouth-Parts. By Vernon L. Kellogg. pp. 118. 14 *plates.*

8. **List of Fishes Collected at Port Ludlow, Wash.** By Edwin Chapin Starks. pp. 14. 2 *plates.*

9. **Marine Fossils from the Coal Measures of Arkansas.** By James Perrin Smith. pp. 72. 9 *plates.*

10. **Scientific Names of Greek and Latin Derivation.** By Walter Miller. pp. 31.

11. **A Morphological Study of Naias and Zannichellia.** By Douglas Houghton Campbell. pp. 68. 5 *plates.*

12. **Geology of the Paleozoic Area of Arkansas South of the Novaculite Region.** By George H. Ashley. 31 *cuts.* 2 *maps.*

13. **The Development of Glyphioceras and the Phylogeny of the Glyphioceratidæ.** By James Perrin Smith. pp. 28. 3 *plates.*

14. **A Geological Reconnaissance of the Coal Fields of the Indian Territory.** By Noah Fields Drake. pp. 93.

15. **Description of a Species of Fish (Mitsukurina owstoni) from Japan, the Type of a Distinct Family of Lamnoid Sharks.** By David Starr Jordan. pp. 5. 2 *plates.*

16. **The Development of Lytoceras and Phylloceras.** By James Perrin Smith. pp. 32. 5 *plates.*

(Continued on Third Page of Cover.)

CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
OF THE
LELAND STANFORD JR. UNIVERSITY

XXXI

The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California

By RALPH ARNOLD

[Reprinted from the Memoirs of the California Academy of Sciences
Vol. III]

STANFORD UNIVERSITY, CALIFORNIA
1903

.G6413
v.31-32

THE PALEONTOLOGY AND STRATIGRAPHY OF THE MARINE PLIOCENE AND PLEISTOCENE OF SAN PEDRO, CALIFORNIA

A dissertation presented to the Faculty in Geology of the Leland
Stanford Junior University, for the degree of
Doctor of Philosophy.

PREFATORY NOTE.

This memoir is the thirty-first of a series designed to illustrate investigations and explorations connected with the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. These investigations have been carried on by means of the assistance given by Timothy Hopkins, Esq., of Menlo Park, California. This memoir appears in the publications of the California Academy of Sciences, the present edition being a reprint.

OLIVER P. JENKINS,
CHARLES H. GILBERT,
Directors Hopkins Laboratory.

Date of publication, June 27, 1903.

THE PALEONTOLOGY AND STRATIGRAPHY OF THE MARINE PLIOCENE AND PLEISTOCENE OF SAN PEDRO, CALIFORNIA.

BY RALPH ARNOLD.

CONTENTS.

Plates I–XXXVII.

Page
Introduction and Acknowledgments 9

Part I. General Discussion.

CHAPTER I. TOPOGRAPHY AND GEOLOGY OF SAN PEDRO 11
- 1. Topography 11
- 2. General Geology 12
- 3. Pliocene 14
  - *Deadman Island* 14
  - *Timm's Point* 17
- 4. Pleistocene 17
  - *The San Pedro Series* 17
  - *Lower San Pedro Series* 18
  - *Upper San Pedro Series* 23
  - *Raised Beach Formation* 33
- 5. Post-Pleistocene Deposits 33
- 6. Alphabetical List showing the distribution of Species in the vicinity of San Pedro 34

CHAPTER II. THE UPPER PLIOCENE AND PLEISTOCENE FORMATIONS OF OTHER LOCALITIES ON THE PACIFIC COAST 48
- Puget Sound South to Pismo, San Luis Obispo County 48
- Santa Barbara and Vicinity South to San Juan Capistrano 50
  - *Ventura* 53
  - *Port Los Angeles* 56
  - *San Clemente Island* 56
  - *Newport* 56
  - *San Juan Capistrano* 57
- San Diego and Vicinity 57
  - *Pacific Beach—Pliocene* 57
  - *Pacific Beach—Pleistocene* 58
  - *San Diego Mesa—Pliocene* 59
  - *Twenty-sixth Street—Pleistocene* 59
  - *Spanish Bight—Pleistocene* 59

CHAPTER III. FAUNAL RELATIONS 65
- 1. Pliocene 65
- 2. Pleistocene 66
  - *The Lower San Pedro Series* 66
  - *The Upper San Pedro Series* 66
- 3. Relation of the Late Pliocene, Pleistocene, and Living Faunas of California to the Fauna of Japan 67

PART II. THE PLIOCENE AND PLEISTOCENE FAUNA OF SAN PEDRO AND VICINITY.

SYNOPSIS 71
DESCRIPTION OF SPECIES 86

PART III. BIBLIOGRAPHY.

EXPLANATION OF PLATES 364
INDEX 405

INTRODUCTION AND ACKNOWLEDGMENTS.

The field work upon which this paper is based began in the winter of 1886, when the writer first visited the fossil-bearing beds of San Pedro. Since that time several visits have been made each year to the beds in that vicinity, generally after heavy rains, when landslides and the breaking off of the banks have given new

ERRATA.

Page 107, last line, after (Cooper) insert San Pedro; Santa Barbara (Arnold).
Page 112, 17th line, for "*flucicolus*" read *fucicolus*.
Page 142, last line, after *Cytherea* insert *radiata* Sby.
Page 144, 4th line from bottom, after *Carpenter* insert var.
Page 145, 4th line, for "*C. diaphana*" read *C. subdiaphana*.
Page 166, 12th line from bottom, after *Sowerby* insert var.
Page 185, top line of foot-note, for "Dr. W. N. Dall" read Dr. W. H. Dall.
Page 233, 11th line from bottom, for "*M. woodwardi*" read *N. woodwardi*, and for "*gibbsii*" read *gibbesii*.
Page 243, 5th line, for "*tenuispena*" read *tenuispina*.
Page 253, 7th line, for "stuarti *Smith* var." read orpheus var.
Page 307, 17th and 19th lines, for "*Calyptrea*" read *Calyptræa*.
Page 339, 3rd line, for "*Fissuridæ*" read *Fissuridea*.

3. California Academy of Sciences: Paleontological and Conchological collections.

4. The private collection of Mrs. M. Burton Williamson, Los Angeles, California.

5. The private collection of Mrs. T. S. Oldroyd, Los Angeles, California.

6. The private collection of Mr. Henry Hemphill, San Diego, California.

Dr. James Perrin Smith, Professor of Paleontology in Leland Stanford Junior University, has had general supervision of this paper during its preparation. He has accompanied the writer on journeys that covered much of the territory under discussion, and has offered many valuable suggestions regarding the faunal relations and stratigraphy of the San Pedro formations.

The writer is indebted to Dr. John C. Branner, Professor of Geology in Leland Stanford Junior University, for valuable suggestions in regard to the field work and compilation of this paper.

Dr. William Healey Dall, of the United States National Museum, has identified numerous specimens sent to him, acknowledgment for which is given with each species. Dr. Dall has also prepared the diagnoses of the family Pyramidellidae, and has furnished drawings of the species of that family, and for the corals; and in many other ways has extended courtesies during the preparation of this work.

Dr. John C. Merriam, of the University of California, has given free access to all of the collections under his charge; has extended many other courtesies; and has offered suggestions which have added to the value of the paper.

The writer is indebted to his father, Delos Arnold, for the use of his collection; for notes and suggestions on the stratigraphy of the San Pedro deposits; for assistance in the preparation of the drawings; and, most of all, for the interest manifested by him in procuring the material upon which much of this paper is based. The field work and collecting has been done as much by him as by the writer. For the past fifteen years he has made numerous visits each year to the San Pedro beds, and to his untiring efforts is due the discovery of such a large number of species in them. He has also visited and made systematic collections from the deposits of Santa Barbara, Ventura, San Diego and other localities along the southern California coast.

Acknowledgment is also due to Mr. T. Wayland Vaughan, Dr. R. E. C. Stearns, Mr. Henry Hemphill, Dr. A. A. Wright, Mr. J. Howard Wilson, and others.

The illustrations are from drawings by Dr. J. C. McConnell, Misses Winnifred M. Paine and Fanny H. Mitchell, Messrs. H. R. Johnson, R. E. Renaud and R. Arnold.

Where the types of new species belonged to Delos Arnold, these types have been deposited in the United States National Museum at Washington, and, where possible, duplicates will be deposited in the paleontological collections of the California Academy of Sciences, and of Leland Stanford Junior University.

PART I. GENERAL DISCUSSION.

CHAPTER I.

TOPOGRAPHY AND GEOLOGY OF SAN PEDRO.

1. TOPOGRAPHY.

THE most prominent topographic feature about San Pedro is San Pedro Hill, an abruptly projecting headland of the coast, rising to a height of 1,482 feet. Along its southern base is a sea cliff varying in height from one hundred to three hundred feet, while to the east the cliff rarely exceeds fifty feet in height. The hill is terraced to within two hundred and forty feet of its summit, and the observations here recorded began on the lowest, or fifty-foot terrace, at the eastern limit of the hill. (See map, Plate XXIII.)

This terrace extends from a point about one-half mile east of the Point Fermin lighthouse to a bluff about a half mile north of the business center of the town of San Pedro. The sea cliff bounding this terrace runs due north for nearly a mile and a half from Point Fermin, then bends abruptly at old San Pedro, popularly known as "Crawfish George's," and runs northeastward for half a mile to Timm's Point. From this point the bluff runs due north for over a mile, broken only by a little valley in which the business portion of San Pedro is located. At the north end of this bluff the escarpment bends sharply toward the northwest, and is broken along the northern front by several valleys that run down from San Pedro Hill.

Half a mile southeast of Timm's Point is Deadman Island, a small fragment of the San Pedro terrace, which has withstood the eroding agents that have cut it off from the mainland, but which is now being worn away rapidly by the waves. It is a triangular bit of land about fifty feet high, with an area on top of about three hundred square yards. Deadman Island is joined by a breakwater to Rattlesnake Island, or Terminal Island, as it is now called, a narrow barrier beach, which begins at a point directly opposite San Pedro and runs to Old River—the former mouth of the Los Angeles River—about four miles distant.

About a mile east from Old River a ten-foot bank forms the eastern limit of the marsh lands and the western edge of a plain that rises toward the east for about three and a quarter miles, where it is terminated by a bluff. The bluff, which forms the coast-line of this plain, gradually rises in height from ten feet at its western extremity to over fifty feet at about its middle. The eastern half is of a nearly uniform height of fifty feet.

The town of Long Beach is situated on the plain that slopes gradually back from this bluff. Two and a half miles north of Long Beach is Los Cerritos, or Signal Hill, as it is commonly called, the most prominent point in a series of low hills extending to Dominguez Hill, six miles to the northwest. Los Cerritos is three hundred and sixty-four feet high. Its northern side is smooth and slopes gently into the great Los Angeles plain. Its southern slope is much steeper, and is cut by many deep, narrow ravines, which offer a fine opportunity for studying the geology of the hill.

2. General Geology.

The oldest formation exposed in the immediate vicinity of San Pedro is the Miocene, or Monterey series. The shales of this formation are exposed along the sea cliff on the eastern end of San Pedro Hill, and also at Deadman Island. After the deposition of the Miocene the shale beds were raised and contorted and subjected to erosion. During the Pliocene period a submergence took place and a deposit of fine, yellow, clayey sand of unknown thickness was laid down on the surface of the eroded Miocene shales.

A post-Pliocene uplift laid bare the sandstones, which were worn away completely from some parts of the eastern base of San Pedro Hill. Timm's Point and Deadman Island are the only places at which they are now exposed.

Again there was a change of conditions. The eroded surface of the Pliocene became sea bottom, and deposits of fine, gray, silicious sand, extremely fossiliferous in places, were laid down unconformably on it. This particular horizon is represented by the gray sand deposit of Deadman Island, by the gray, sandy strata exposed along the bluff southeast of San Pedro and in the lower part of the continuation of this bluff just north of the San Pedro valley. The lower series of sandstones and conglomerates of Los Cerritos may be contemporaneous with these last mentioned beds. On account of its fauna and its unconformable position on the Pliocene this horizon is thought to be of Pleistocene age. It is called in this paper the lower San Pedro series. The maximum thickness of this particular horizon, so far seen, does not exceed fifty feet.

After the lower San Pedro there was a period of shallow water, lagoon and dune conditions prevalent along this part of the coast, during which the conglomerates of Deadman Island, San Pedro and Los Cerritos were laid down, and the sandy formations in the bluffs one-half mile north of San Pedro and along the Long Beach water front were deposited. This period was one of rapidly changing conditions, as is shown by sand-dune deposits and by the nearly horizontal aqueous deposits of both fine sand and gravels in alternating beds. These beds dip gently away from the centers of uplift, and many of the strata are very fossiliferous. This series of strata is called the upper San Pedro series. The maximum thickness of the strata of this horizon is over fifty feet, as is shown by the exposure in the sea-cliff southeast of Long Beach.

Overlying all these deposits is the alluvial soil, varying in depth from two to ten feet, mostly adobe, and filled in some places, notably along the San Pedro bluffs and Deadman Island, with the shells of edible mollusks. These refuse heaps, or ancient kitchen-middens, are abundant on this part of the coast.

CORRELATION TABLE OF THE MARINE PLIOCENE AND PLEISTOCENE OF CALIFORNIA.

(Dotted lines indicate conformable strata; full lines, nonconformable.)

Maximum thickness	Pliocene	Pliocene	Pleistocene	Pleistocene	Pleistocene	Pleistocene	Epoch
	Merced Series	Merced Series	Merced Series / San Pedro Series		San Pedro Series	Recently Raised Beaches	FORMATION.
		San Diego Formation Lower	San Diego Formation Upper				
			Lower		Upper		
Pleistocene 70′ Pliocene 180′		San Diego well 150′	Russ School 50′	Wanting.	Foot of 26th St. 20′		SAN DIEGO SECTION.
					Spanish Bight 20′		
		Pacific Beach (lower horizon) 180′+	Pac. Beach (upper horizon) 20′±		Pacific Beach 15′		
Pleistocene 100′ Pliocene 50′		Deadman Island 45′ Wanting.	Deadman Island 12′		Deadman Island 10′	Deadman Is. 4′	SAN PEDRO SECTION.
		Timm's Point 50′	San Pedro Bluffs 50′		Lumber yard 20′		
					Crawfish George's 3′		
			Los Cerritos 50′+		Los Cerritos 20′		
					Long Beach 50′		
Pleistocene 1000′+			Old irrigating ditch (?)		Old irrigating ditch 1000′±		VENTURA SECTION.
					Barlow's Ranch 100′+		
Pleistocene 60′ Pliocene 200′		Packard's Hill 200′+	Bluff at bath house 30′		Bluff ¼ mile west of bath house 25′		SANTA BARBARA SECTION.
					Bluff 2 miles east of wharf 30′		
Pleistocene 350′+ Pliocene 5000′±	Lake Merced to Mussel Rock below "upper gastropod bed." 5000′±		"Upper gastropod bed" to unconformity. 150′±		"Terrace formation." Soft sediments above unconformity. 200′±		LAKE MERCED SECTION.
Pleistocene (Bell Station) 1320′		San Juan Capistrano			Newport, Orange County.	Blakeley, Washington 16′	OTHER LOCALITIES.
					Bell Station, Los Angeles County 1320′		
			Port Los Angeles, fossiliferous bed 50′±		Port Los Angeles, upper soft strata 150′±		
					San Pablo Bay, oyster beds		

3. PLIOCENE.

Deadman Island.—Overlying the Miocene shale of Deadman Island (see diagram *B*, Pl. XXII) is a deposit of brown, clayey sandstone, varying in thickness from twenty to forty-five feet. The distinct strata of this formation will be described in detail. The surface of jointed shale on which the sandstone rests is worn and uneven, but the contact conforms nearly to the dip of the shale, which is between 20° and 30° northeast. Other evidence beside the worn condition of the shales at the contact goes to show that the erosion took place while the shales formed the sea bottom near the shore. Worm borings are common, and in one place a pholas hole was found in the shale. The contact stratum, which is only about a foot thick, is composed almost wholly of beach-worn pebbles of the Miocene shale, all containing to some extent holes of worms and mollusks. It contains also many well preserved shells and shell fragments. All of the fossils common in this layer are found in the sandstone just above it, so its fauna will be taken up with that of the overlying sandstone in a later part of this paper.

This bottom Pliocene layer dips northeast at an angle of about 25°. Towards the top of the formation the bedding planes become more nearly horizontal, those at the top having a dip of only 8° or 10°. This could be accounted for in one of two ways—either the lowest layer was deposited horizontally and then during the deposition of the subsequent layers there was a gradual uplift toward the southwest, or else the lowest layer was deposited on a sloping bottom, and the general tendency of sediments to settle in the lower portions of their basins and to form horizontal beds gradually overcame the dip.

About eight feet of fine, brownish yellow, clayey sand rests on the pebbly lowest Pliocene stratum. In some of the places exposed to the action of the sea-water this second Pliocene stratum consists of bluish gray clay, and in some places is filled with well preserved fossils. In the southwest corner of the island the second layer is a hard, fine, brown sandstone containing only a few fossils.

Overlying the second stratum is a fine, dark brown sandstone about four feet thick. The most fossiliferous places are hard, but porous. The fossils in these hard places are well preserved, while those in the softer parts of the layer, which is lighter colored, are poorly preserved and fragile. Pieces of the hard portions of the Pliocene stratum have broken off and have fallen among the fragments of shale along the beach. This has caused some people to report the fossils found in this Pliocene bed as occurring in the Miocene shale. On account of the great abundance of *Thyasira (Cryptodon) bisecta* in this stratum it has been given the local name of "Cryptodon bed." *Lucina acutilineata* is also very common in the Cryptodon stratum.

Above this very fossiliferous stratum is a bed of brown sandstone from twenty-five to thirty-five feet in thickness, only slightly laminated, and varying somewhat in structure and appearance in different parts of the layer. The lower part is uniformly soft, while toward the top the color is lighter and the rock much harder. Only a few fossils, such as *Lucina acutilineata* and *Pecten caurinus*, have been found in the upper brown sandstone stratum. The total thickness of the Pliocene beds at Deadman Island is about forty-five feet.

LIST OF SPECIES FOUND IN THE PLIOCENE OF DEADMAN ISLAND.

(P indicates species living at San Pedro; N indicates species found living only north of San Pedro; E indicates extinct species or those not known as living.)

PELECYPODA.

Callista subdiaphana, N
Chama pellucida, P
Corbula luteola, P
Cumingia californica, P
Kellia laperousii, P
Leda taphria, P
Lucina acutilineata, P
Lucina californica, P
Lyonsia californica, P
Macoma inquinata, P
Mytilimeria nuttalli, P
Nucula castrensis, P
Panomya ampla, N
Panopea generosa, P
Pecten caurinus, N
Pecten hastatus, P
Pecten hericeus, N
Pecten jordani, E
Pecten stearnsii, E
Pholadidea penita, P
Protocardia centifilosa, P
Solen sicarius, P
Thracia trapezoides, E
Thyasira bisecta, N
Thyasira gouldii, P
Venericardia barbarensis, P
Venericardia ventricosa, N
Venus simillima, P

GASTROPODA.

Acmæa insessa, P
Amphissa corrugata, P
Bela fidicula, N
Bittium asperum, P
Calliostoma canaliculatum, P
Calliostoma tricolor, P
Cerithidea californica, P
Chlorostoma brunneum, P
Chlorostoma montereyi, P
Chrysodomus sp. indet., N
Chrysodomus rectirostris, N
Chrysodomus tabulatus, P.
Clathurella conradiana, E
Columbella gausapata, P
Columbella var. *carinata,* P
Conus californicus, P
Cryptochiton stelleri, N
Drillia merriami, E
Drillia torosa, P
Fusus barbarensis, E
Hipponyx antiquatus, P
Littorina planaxis, P
Mangilia sculpturata, P
Nassa californiana, P
Nassa fossata, P
Nassa mendica, P
Nassa var. *cooperi,* P
Nassa perpinguis, P
Natica clausa, N
Neverita recluziana, P
Ocinebra interfossa, P
Olivella biplicata, P
Olivella intorta, P
Olivella pedroana, P
Pleurotoma bartschi, E
Pleurotoma dalli, E
Pleurotoma perversa, P
Pleurotoma renaudi, E
Pleurotoma smithi, E
Priene oregonensis, P
Puncturella cucullata, N
Puncturella galeata, N
Scala indianorum, P
Solariella cidaris, P
Solariella peramabilis, P
Taranus strongi, E
Terebra simplex, P
Thalotia caffea, P
Tornatina eximia, P
Trophon gracilis, P
Trophon scalariformis, N
Trophon stuarti, N
Trophon var. *præcursor,* E
Trophon tenuisculpta, E
Turritella cooperi, P
Turritella jewetti, E

BRACHIOPODA.

Bryozoan remains, ?
Laqueus jeffreysi, N
Terebratalia smithi, E

RESUMÉ.

Total number of species	87
Pelecypoda, species	28
Gastropoda, species	56
Brachiopoda, species	2
Bryozoa, species	?
Species now living at San Pedro	55
Percentage of the whole fauna	63.1
Species living only north of San Pedro	16
Percentage of the whole fauna	18.5
Species living only south of San Pedro	0
Percentage of the whole fauna	0
Species extinct or not known as living	15
Percentage of the whole fauna	17.3
Species of questionable habitat	1
Percentage of the whole fauna	1.2

The fauna of the San Pedro Pliocene is a decidedly northern or boreal one in the sense that many of the species found in the San Pedro Pliocene are living now only in the colder waters far to the north of San Pedro. The large percentage of the living species found now living only north of San Pedro shows this; and in addition, the species in this fauna still living at San Pedro are nearly all of a northern or boreal type. No characteristic southern species are found in this fauna.

The evidence shows that the climate in the vicinity of San Pedro during that part of the Pliocene epoch in which these beds were deposited was probably different from the present one. A boreal fauna deposited in comparatively shallow water near the shore implies a boreal climate, at least in proximity to the coast; the fauna contains so many shallow water species, and the lithologic evidence showing that the deposits containing the fauna were laid down near the shore is so strong, that it cannot be regarded as a deep-water temperate fauna. The evidence, then, shows that during upper Pliocene times the climate of this part of Southern California was colder than at present; and if this was true of southern California, it seems reasonable to infer that the colder climate affected the whole coast from San Pedro northward.

There are several reasons for calling the lower sandstone strata of Deadman Island Pliocene. In the first place, 17.3 per cent. of the fauna of these strata are extinct at the present time. This is conclusive evidence that the beds are not Pleistocene, but are of an earlier epoch. They are overlain unconformably by strata of Pleistocene age, which implies that there was a period of denudation between the epoch of the deposition of the lower beds and the Pleistocene. Besides, these strata rest unconformably upon the Miocene shales. That the Deadman Island Pliocene beds are of upper Pliocene origin is shown by the fact that their fauna gradually grades into the living fauna of San Pedro through that of the overlying Pleistocene beds. The gap between the faunas of the Deadman Island Pliocene and the overlying Pleistocene beds, though distinct, is not wide.

In his correlation paper on the Neocene, Dr. Dall says:[1] "It appears that on Deadman Island near Point Fermin at least three distinguishable strata appear, the uppermost of which is certainly Pleistocene, while the others are Neocene and the middle layer probably Pliocene." The middle layer referred to is the brown sandstone which rests on the Miocene shales.

The Deadman Island Pliocene beds are lithologically and faunally similar to the Pliocene beds at San Diego, and have been correlated with them by Dr. Dall.[2] In the same table he places the San Diego beds below the Merced series. This does not accord with the evidence offered by the San Pedro Pliocene strata. The San Pedro beds are very near the top of the Pliocene, and have a northern fauna; the relative position of the Merced series is uncertain, and it has a fauna containing such southern forms as *Arca* and *Dosinia*, with an echinoderm, *Scutella interlineata*, which has never been found in either the San Diego or San Pedro formations, or in any formation overlying the Merced series. The Merced series has been subject to much more contortion than either the Deadman Island or San Diego Pliocene. The Pliocene age of the Merced series is unquestioned, and it has too great a vertical development to allow of its coming between the Pleistocene and the Deadman Island formation, which is at or near the top of the Pliocene. In the light of this evidence, it is the writer's opinion that the Deadman Island and San Diego Pliocene are above the greater part of the Merced series.

---

[1] Correlation Papers, Neocene. By W. H. Dall and G. D. Harris. Bull. U. S. Geol. Sur., No. 84, 1892, p. 216.

[2] North American Tertiary Horizons. By W. H. Dall. 18th Ann. Rep. U. S. Geol. Sur., Part II, 1898, p. 335.

Timm's Point.—The Pliocene is also exposed at Timm's Point (see diagram *D*, pl. XXII), where it is similar in every respect to the Deadman Island Pliocene, except that the layers are not so distinctly separated as at Deadman Island, and, as a whole, the rocks are not so hard as at the latter place. The Miocene shales at Timm's Point dip northeast at an angle of about 25°; and resting on them in the same relative position as at Deadman Island, is the Pliocene sandstone. The Pliocene is also visible in the railroad cut in the bluff in the southeastern part of San Pedro, where there is a stratum containing numerous specimens of *Thracia trapezoides*. The beds along this cut dip gently in a northerly direction, and are overlain in the cut and to the north of it by the lighter colored Pleistocene sands.

The following species were found in the Pliocene deposits at Timm's Point and in the northward continuation of the same strata in the railroad cut and grade:

LIST OF SPECIES FOUND IN THE PLIOCENE AT TIMM'S POINT.

PELECYPODA.

Callista subdiaphana
Leda taphria
Lucina acutilineata
Nucula castrensis
Pecten caurinus
Pecten jordani
Protocardia centifilosa
Solen sicarius
Thyasira bisecta
Thracia trapezoides
Thyasira gouldii
Venericardia barbarensis
Venericardia ventricosa

GASTROPODA.

Bittium asperum
Chrysodomus tabulatus
Columbella gausapata
Columbella var. *carinata*
Conus californicus
Drillia torosa
Fusus barbarensis
Nassa mendica
Nassa cooperi
Nassa perpinguis
Natica clausa
Olivella biplicata
Terebra simplex
Trophon stuarti
Turritella cooperi

This fauna contains a total of twenty-eight species, of which thirteen are pelecypods and fifteen are gastropods. The fauna, so far as known, is small, not because the beds at that place are barren of fossils, but because little collecting has been done there. The beds are nearly covered with detritus, so that fossils are not easily obtained.

An outcrop of rather hard, fine grained sandstone on the coast about three and one-half miles east of Long Beach has some of the lithologic characters of the Deadman Island Pliocene beds. Although a few fragments of shells were seen in it, no recognizable fossils were obtained from this outcrop, and no definite correlation will therefore be attempted. It may be only a local hardening of the upper San Pedro strata.

4. PLEISTOCENE.

The San Pedro Series.—From the evidence brought forward in this paper it appears probable that most of the Pleistocene, as developed on the coast of California, is represented by the strata of San Pedro and Deadman Island. The writer, therefore, proposes the name San Pedro Series for the series of Pleistocene strata at San Pedro, including the lower and upper formations, as described in the present paper.

Lower San Pedro Series. – A stratum of gray sandstone rests unconformably on the brown Pliocene sandstone of Deadman Island. (See diagram *B*, Pl. XXII.) In some places the sand is soft; in others it has been cemented until it is very hard. The soft parts are not fossiliferous, as a rule, while the hard parts are made up in some places almost wholly of beautifully preserved fossils. One locality in particular on the west side of the island, near the north end, is filled with finely preserved specimens. Parts of this bed are very hard, making it almost impossible to get the shells out, while other parts are so soft that the shells can be removed from the matrix with the fingers. This stratum varies in thickness from four to ten feet on the west side to nearly twenty feet on the east side of the island. There seems to be little indication of bedding planes in this stratum. The general dip is to the north. On account of its lying unconformably on the Pliocene, being of different lithological composition, and containing a fauna of which a great number of species have never been found in the Pliocene, this horizon is designated in the present paper as the lower San Pedro series, or the lower part of the Pleistocene. The following species have been obtained from the lower San Pedro gray sand stratum of Deadman Island:

LIST OF THE FOSSILS OF THE LOWER SAN PEDRO BEDS (LOWER PLEISTOCENE) OF DEADMAN ISLAND.

(P indicates species living at San Pedro; N indicates species living only north of San Pedro; S indicates species living only south of San Pedro; E indicates extinct species or those not known as living.)

PELECYPODA.

Angulus buttoni, P
Anomia lampe, P
Bornia retifera, N
Callista var. *pedroana*, E
Cardium corbis, N
Cardium procerum, S
Chama pellucida, P
Clidiophora punctata, P
Cooperella subdiaphana, P
Corbula luteola, P
Cryptomya californica, P
Cumingia californica, P
Diplodonta orbella, P
Donax californica, P
Donax lævigata, P
Kellia laperousii, P
Kellia suborbicularis, P
Kennerlia bicarinata, N
Kennerlia filosa, N
Lævicardium substriatum, P
Lazaria subquadrata, P
Leda fossa, N
Leda hamata, P
Leda var. *præcursor*, N
Leda taphria, P
Lima dehiscens, P
Lucina acutilineata, P
Lucina californica, P
Lucina nuttalli, P
Lyonsia californica, P
Macoma calcarea, N
Macoma inquinata, P
Macoma nasuta, P
Macoma secta, P
Macoma yoldiformis, P
Mactra falcata, P
Metis alta, P
Modiola fornicata, N
Modiola recta, P
Mœrella salmonea, N
Mytilus edulis, P
Mytilimeria nuttalli, P
Neæra pectinata, P
Nucula castrensis, P
Nucula suprastriata, N
Ostrea lurida, P
Panopea generosa, P
Pecten caurinus, N
Pecten hastatus, P
Pecten hericeus, N
Pecten var. *strategus*, N
Pecten jordani, E
Pecten latiauritus, P
Pecten var. *monotimeris*, P
Petricola carditoides, P
Petricola denticulata, S
Protocardia centifilosa, P
Psephis salmonea, N
Psephis tantilla, N
Racta undulata, P
Saxidomus aratus, P
Semele var. *montereyi*, N
Septifer bifurcatus, P
Siliqua lucida, P
Solen rosaceus, P
Solen sicarius, P
Tapes staminea, P
Tellina bodegensis, P
Tivela crassatelloides, P
Venericardia barbarensis, P
Venericardia ventricosa, N
Venus simillima, P
Verticordia novemcostata, P
Yoldia scissurata, P

GASTROPODA.

Acmæa insessa, P
Acmæa pelta, P
Acmæa spectrum, P
Actæon punctocælata, P
Admete gracilior, E
Amphissa corrugata, P
Amphissa ventricosa, E
Amphissa versicolor, P
Bela fidicula, N
Bela sanctæ-monicæ, E
Bittium asperum, P
Bittium californicum, E
Bittium filosum, N
Bittium quadrifilatum, P
Bittium rugatum, P
Cæcum californicum, P
Cæcum crebricinctum, P
Cæcum magnum, ?
Calliostoma canaliculatum, P
Calliostoma costatum, P
Cerithidea californica, P
Chlorostoma funebrale, P
Chlorostoma var. *subapertum* P
Chlorostoma montereyi, P
Chlorostoma var. *ligulatum*, P
Chrysodomus rectirostris, N
Chrysodomus tabulatus, P
Cluthurella conradiana, E
Clipidella bimaculata, N
Clipidella callomarginata, P
Columbella californiana, P
Columbella chrysalloidea, P
Columbella gausapata, P
Columbella var. *carinata*, P
Columbella oldroydi, E
Columbella tuberosa, P
Conus californicus, P
Crepidula aculeata, P
Crepidula adunca, P
Crepidula dorsata, P
Crepidula navicelloides, P
Crepidula onyx, S
Crepidula rugosa, P
Cryptochiton stelleri, N
Cylichna alba, P
Cythara branneri, E
Diastoma, sp. indet., ?
Drillia cancellata, N
Drillia hemphilli, S
Drillia inermis, P
Drillia merriami, E
Drillia montereyensis, N
Drillia var. *penicillata*, P
Drillia torosa, P
Eulima falcata, S
Eulima hastata, S
Eulima micans, P
Eupleura muriciformis, S
Fissuridea aspera, P
Fissuridea murina, P
Fissurella volcano, P
Fusus barbarensis, E
Fusus luteopictus, P
Fusus robustus, P
Fusus rugosus, P
Galerus mammillaris, P
Hipponyx antiquatus, P
Hipponyx cranioides, N
Hipponyx tumens, P
Isapis fenestrata, P
Ivara terricula, ?
Lacuna compacta, N
Lacuna porrecta, N
Lacuna solidula, P
Lamellaria stearnsii, P
Leptothyra bacula, P
Leptothyra carpenteri, P
Leptothyra paucicostata, N
Littorina planaxis, P
Littorina scutulata, P
Mangilia angulata, N
Mangilia var. *pedroana*, E
Mangilia interlirata, P
Mangilia oldroydi, E
Mangilia painei, E
Margarita var. *nodosus*, P
Margarita var. *pedroana*, P
Marginella jewetti, P
Melampus olivaceus, P
Mitramorpha filosa, P
Mitramorpha intermedia, E
Monoceros engonatum, P
Murex festivus, P
Nassa californiana, P
Nassa fossata, P
Nassa mendica, P
Nassa var. *cooperi*, P
Nassa perpinguis, P
Nassa tegula, P
Natica clausa, N
Neverita recluziana, P
Ocinebra barbarensis, P
Ocinebra interfossa, P
Ocinebra var. *aspera*, N
Ocinebra var. *cerritensis*, E
Ocinebra var. *munda*, N
Ocinebra perita, P
Ocinebra poulsoni, P
Odostomia gouldii, P
Odostomia var. *avellana*, N
Olivella biplicata, P
Olivella intorta, P
Olivella pedroana, P
Phasianella compta, P
Pleurotoma bartschi, E
Pleurotoma dalli, E
Pleurotoma hooveri, E
Pleurotoma pedroana, E
Pleurotoma perversa, P
Pleurotoma renaudi, E
Pleurotoma smithi, E
Priene oregonensis, P
Puncturella cucullata, N
Puncturella galeata, N
Scala hindsii, P
Scala indianorum, P
Scala tincta, P
Seila assimilata, P
Serpulorbis squamigerus, P
Styliferina tenuisculpta, ?
Taranis strongi, E
Terebra simplex, P
Thalotia caffea, P
Tornatina cerealis, P
Tornatina culcitella, P
Triforis adversa, N
Trophon cerritensis, E
Trophon gracilis, P
Trophon multicostatus, N
Trophon pedroana, E
Trophon scalariformis, N
Trophon stuarti, N
Trophon var. *præcursor*, E
Trophon triangulatus, P
Turbonilla adleri, E
Turbonilla arnoldi, E
Turbonilla aurantia, P
Turbonilla crebrifilata, P
Turbonilla gibbosa, P
Turbonilla laminata, P
Turbonilla lowei, E
Turbonilla muricata, P
Turbonilla pentalopha, P
Turbonilla similis, P
Turbonilla subcuspidata, S
Turbonilla tenuicula, P
Turbonilla torquata, N
Turbonilla var. *stylina*, N
Turbonilla tridenta, N
Turritella cooperi, P
Turritella jewetti, E
Vermicularia, sp. indet., ?
Vitrinella williamsoni, P
Volvarina varia, P
Volvula cylindrica, P

SCAPHOPODA.

Cadulus nitentior, ?
Dentalium hexagonum, P
Dentalium indianorum, N
Dentalium pseudohexagonum, ?

ECHINOIDEA.

Echinarachnius excentricus, P *Strongylocentrotus franciscanus*, P *Strongylocentrotus purpuratus*, P

CRUSTACEA

Cancer breweri, E

RÉSUMÉ.

Total number of species		247
Pelecypoda, species		74
Gastropoda, species		165
Scaphopoda, species		4
Echinoidea, species		3
Crustacea, species		1
Species living at San Pedro		158
Percentage of fauna	64	
Species living only north of San Pedro		43
Percentage of fauna	17.4	
Specimens living only south of San Pedro		8
Percentage of fauna	3.2	
Species extinct		31
Percentage of fauna	12.5	
Species of questionable habitat		7
Percentage of fauna	3	

This is also a cold water fauna. Not only is there a large percentage of species which are found living only north of San Pedro at the present time, but of those species in the fauna which are now living at San Pedro, a great many are northern forms. A few distinctly southern forms are found in the fauna, however, which shows that the cold climatic conditions prevalent along this part of the coast during the upper Pliocene times were beginning to give place to more temperate conditions in the early part of the Pleistocene. The fauna of the lower San Pedro series is a transitional one between the boreal fauna of the Pliocene and the warm water fauna of the upper San Pedro series. The climatic conditions were therefore changing during lower Pleistocene times; and the climate at the end of the period of deposition of the lower San Pedro deposits was much warmer than that at the end of the period of deposition of the Pliocene. The period of denudation between the Pliocene and Pleistocene epochs was one during which the conditions were also changing.

The lower San Pedro deposits are thought by the writer to be of Pleistocene origin, for several reasons. First, we have a fauna with a low percentage of extinct species. (The high percentage of the list given above is due to the large number of new species and varieties, many of which are close to living forms and are probably living, but which have not been reported.) The large number of species found in this fauna which have never been found in beds of known Pliocene origin, and the lack of several of the typical Pliocene species from its fauna, offer two of the strongest arguments in favor of the Pleistocene age of the lower San Pedro series. The state of preservation of the fossils is also an item in favor of their comparatively recent deposition. It is worthy of note that in several cases the original coloration of the shells of lower San Pedro fossils is still preserved. The sands, too, of this formation are always much less oxidized than those of the underlying Pliocene. An unconformity between this formation and the Pliocene also suggests a lapse of time between the two.

Dr. Lawson in discussing the movements that have taken place during late Tertiary and Pleistocene times in the vicinity of San Pedro, says:[1] "It follows that, while there is a very profound physical break between the Miocene and Pliocene, the marine Pliocene and Pleistocene formations are intimately associated, with no epoch of subaërial denudation between them." The observations of the writer also show this to be true, although in some places there is evidence of local denudation between the Pliocene and Pleistocene. At Deadman Island, in particular, there is evidence of a period of denudation between the two.

Beds of a fine gray sand, with gentle north dip, rest upon the Pliocene exposed along the railroad grade leading up to the cut in the bluff in the southeastern portion of San Pedro. (See diagram *D*, Pl. XXII.) The exact relation between these gray sands and the underlying Pliocene is uncertain, as detritus covers the contact along the face of the bluff. But the gray sand beds seem to rest almost conformably on the yellow Pliocene deposits, both having a low dip toward the north. One of the layers of gray sand near the top of the bluff north of the railroad grade contains a fauna similar to that of the lower San Pedro stratum of Deadman Island. This stratum is exposed in the bluff to the north of the San Pedro valley, and also in two small cuts in the bluff west of the business portion of the town. These gray sand strata were continuous at one time, the San Pedro valley, which cuts them, having been formed by recent erosion.

In the bluff to the north of the valley the fossiliferous lower San Pedro stratum is about forty feet above tide level and dips northward, disappearing under detritus at the mouth of a small ravine about three hundred yards from the southern end of the bluff, but appearing again north of the ravine at the base of the bluff. Underlying this lower San Pedro bed are gray sandy strata which correspond to the lower part of this same formation south of the valley, and which are unfossiliferous, except in a few places. The following fossils have been found in the lower San Pedro beds in the San Pedro bluffs.

List of Fossils of the Lower San Pedro Beds at the San Pedro Bluffs.

PELECYPODA.

Angulus buttoni
Anomia lampe
Cardium corbis
Corbula luteola
Cryptomya californica
Cumingia californica
Donax californica
Donax lævigata
Hinnites giganteus
Kellia laperousii
Kellia suborbicularis
Lævicardium substriatum
Lazaria subquadrata
Leda var. *præcursor*
Leda taphria
Lucina acutilineata
Lucina californica
Lucina nuttalli
Lyonsia californica
Macoma nasuta
Macoma secta
Macoma yoldiformis
Mactra falcata
Mytilimeria nuttalli
Nucula castrensis
Nucula suprastriata
Ostrea lurida
Pecten latiauritus
Pecten var. *monotimeris*
Psephis salmonea
Psephis tantilla
Semele decisa
Siliqua lucida
Solen rosaceus
Solen sicarius
Tapes staminea
Tellina bodegensis

---

[1] Post-Pliocene Diastrophism of the Coast of Southern California. By A. C. Lawson. Bull. Dept. Geol., Univ. of California Vol. 1, 1893, p. 128.

GASTROPODA.

Acmæa insessa
Actæon punctocælata
Bittium filosum
Bittium quadrifilatum
Bittium rugatum
Cæcum californicum
Cæcum crebricinctum
Cæcum magnum.
Calliostoma canaliculatum
Calliostoma costatum
Calliostoma tricolor
Cerithidea californica
Chlorostoma funebrale
Chlorostoma var. *subapertum*
Chlorostoma var. *ligulatum*
Chrysodomus tabulatus
Clathurella conradiana
Clipidella bimaculata
Clipidella callomarginata
Columbella californiana
Columbella chrysalloidea
Columbella gausapata
Columbella var. *carinata*
Columbella tuberosa
Conus californicus
Crepidula aculeata
Crepidula adunca
Crepidula navicelloides
Crepidula onyx
Crucibulum spinosum
Drillia hemphilli
Drillia var. *penicillata*
Drillia torosa
Eulima micans
Fissuridea aspera
Fissurella volcano
Galerus mammillaris
Hipponyx cranioides
Hipponyx tumens
Isapis fenestrata
Lacuna porrecta
Leptothyra carpenteri
Littorina planaxis
Littorina scutulata
Mangilia angulata
Margarita var. *knechti*
Margarita var. *nodosus*
Margarita var. *pedroana*
Marginella jewetti
Melampus olivaceus
Mitra maura
Monoceros engonatum
Nassa fossata
Nassa mendica
Nassa var. *cooperi*
Nassa perpinguis
Nassa tegula
Neverita recluziana
Ocinebra barbarensis
Ocinebra interfossa
Ocinebra var. *aspera*
Ocinebra var. *cerritensis*
Ocinebra poulsoni
Odostomia gouldii
Odostomia tenuis
Olivella biplicata
Olivella intorta
Olivella pedroana
Pachypoma inæquale
Paludestrina curta
Paludestrina stokesi
Phasianella compta
Physa heterostropha
Planorbis tumidus
Planorbis vermicularis
Pleurotoma perversa
Scala crebricostata
Scala hindsii
Scala indianorum
Scala tincta
Serpulorbis squamigerus
Taranis strongi
Terebra simplex
Tornatina cerealis
Tornatina culcitella
Trophon pedroana
Turbonilla aurantia
Turbonilla crebrifilata
Turbonilla laminata
Turbonilla lowei
Turbonilla muricata
Turbonilla similis
Turbonilla stearnsii
Turbonilla subcuspidata
Turbonilla tenuicula
Turbonilla var. *stylina*
Turbonilla tridenta
Turritella cooperi
Volvarina varia

SCAPHOPODA.

Dentalium hexagonum
Dentalium indianorum

CRUSTACEA.

Balanus concavus

ECHINOIDEA.

Echinarachnius excentricus

This fauna comprises one hundred and forty species, of which thirty-seven are pelecypods, ninety-nine are gastropods, two are scaphopods, one is a crustacean, and one an echinoderm. The fauna of the lower beds of the San Pedro bluffs approaches a little nearer that of the upper San Pedro series than does the fauna of the same formation on Deadman Island. This may mean that part of the lower San Pedro beds was removed from the Deadman Island deposit before the deposition of the upper Pleistocene strata.

The following species occur in the lower San Pedro deposits of the San Pedro bluffs which have not been reported from the same horizon of Deadman Island:

LIST OF FOSSILS FROM THE LOWER SAN PEDRO BEDS OF THE SAN PEDRO BLUFFS NOT FOUND AT DEADMAN ISLAND.

(P indicates species living at San Pedro; N indicates species living only north of San Pedro; S indicates species living only south of San Pedro; E indicates extinct species, or species not known as living.

PELECYPODA.

Hinnites giganteus, P
Semele decisa, P

GASTROPODA.

Calliostoma tricolor, P
Crucibulum spinosum, P
Margarita var. *knechti*, E
Odostomia tenuis, P
Pachypoma inæquale, P
Paludestrina curta, E
Paludestrina stokesi, E
Physa heterostropha, P
Planorbis tumidus, S
Planorbis vermicularis, N
Scala crebricostata, P
Turbonilla stearnsii, S

Upper San Pedro Series.—Resting on the gray sandstone of the lower San Pedro series at Deadman Island is a stratum of fossiliferous gravel hardened by calcareous cement. (See Diagram *B*, Pl. XXII.) This stratum, which extends over the whole island at about six feet below the surface, is from two to three feet in thickness. The matrix varies from fine sand to water-worn pebbles of Miocene shale, many of which are full of pholas holes still containing the shell. The fossils are well preserved, and, in all but a few localities of exceptional hardness, may be removed from the matrix with the fingers. This stratum lies nearly horizontal. Water-worn boulders of the gray lower San Pedro sandstone occur in the upper San Pedro conglomerate at Deadman Island. This evidence indicates an unconformity between the lower and upper San Pedro series. Similar evidence is noticeable in the bluff north of the San Pedro valley.

LIST OF FOSSILS FROM THE UPPER SAN PEDRO GRAVEL STRATUM, DEADMAN ISLAND.

PELECYPODA.

Angulus buttoni
Cardium corbis
Chama pellucida
Cryptomya californica
Cumingia californica
Donax lævigata
Glycymeris barbarensis
Glycymeris septentrionalis
Hinnites giganteus
Lævicardium substriatum
Leda taphria
Lucina acutilineata
Lucina californica
Lucina nuttalli
Lyonsia californica
Macoma inquinata
Macoma nasuta
Macoma secta
Mactra catilliformis
Mactra falcata
Metis alta
Modiola recta
Mytilus edulis
Panopea generosa
Pecten latiauritus
Pecten var. *monotimeris*
Pecten subnodosus
Pecten ventricosus
Periploma argentaria
Petricola carditoides
Pholadidea penita
Platyodon cancellatus
Pododesmus macroschisma
Psephis tantilla
Rupellaria lamellifera
Saxidomus aratus
Semele decisa
Solen rosaceus
Solen sicarius
Tagelus californianus
Tapes staminea
Tapes tenerrima
Tellina bodegensis
Tivela crassatelloides
Tresus nuttalli
Venus simillima
Venus succincta
Zirphæa gabbi

GASTROPODA.

Acmæa insessa
Acmæa spectrum
Amphissa versicolor
Bittium quadrifilatum
Bittium rugatum
Bulla punctulata
Calliostoma canaliculatum
Cerithidea californica
Chlorostoma brunneum
Chlorostoma funebrale
Chlorostoma var. *subapertum*
Chlorostoma gallina
Chlorostoma montereyi
Chlorostoma var. *ligulatum*
Columbella gausapata
Columbella var. *carinata*
Columbella tuberosa
Conus californicus

Crepidula adunca
Crepidula grandis
Crepidula navicelloides
Crepidula onyx
Crepidula rugosa
Crucibulum spinosum
Cypraea spadicea
Drillia var. *penicillata*
Drillia torosa
Eupleura muriciformis
Fissuridea aspera
Fissuridea inaequalis
Fissuridea murina
Fissurella volcano
Fusus barbarensis
Fusus luteopictus
Fusus robustus
Haliotis fulgens
Hipponyx cranioides
Hipponyx tumens
Isapis fenestrata
Lacuna porrecta
Littorina scutulata
Margarita var. *pedroana*
Marginella jewetti
Melampus olivaceus
Mitra maura
Monoceras engonatum
Murex festivus
Murex trialatus
Nassa californiana
Nassa fossata
Nassa mendica
Nassa var. *cooperi*
Nassa perpinguis
Nassa tegula
Natica lewisii
Neverita recluziana
Norrisia norrisii
Ocinebra interfossa
Ocinebra keepi
Ocinebra var. *aspera*
Ocinebra perita
Ocinebra poulsoni
Olivella biplicata
Olivella intorta
Olivella pedroana
Pisania fortis
Pleurotoma carpenteriana
Pleurotoma perversa
Priene oregonensis
Purpura crispata
Ranella californica
Scala crebricostata
Scala hindsii
Scala indianorum
Scala tincta
Serpulorbis squamigerus
Spiroglyphus lituella
Terebra simplex
Tornatina culcitella
Turritella cooperi
Turritella jewetti
Volvarina varia

CRUSTACEA.

Balanus concavus

ECHINOIDEA.

Echinarachnius excentricus

SCAPHOPODA.

Dentalium semipolitum
Dentalium hexagonum

This fauna comprises one hundred and thirty-four species, of which forty-eight are pelecypods, eighty-two are gastropods, two are scaphopods, one is a crustacean, and one is an echinoderm. This fauna is not as large as that of the upper San Pedro series at the north end of the San Pedro bluff, so the discussion of the fauna will follow the list of species obtained from the latter locality.

There is a railroad cut a few feet in depth near the southwestern limit of the San Pedro terrace. (See *D*, diagram *E*, Pl. XXIII.) On both sides of this cut there is exposed a bed of gravel consisting of sand, numerous well preserved fossils, and water-worn pebbles of Miocene shale, many of which are full of pholas holes. The bed is from two to three feet thick, and rests unconformably on the upturned edges of the Miocene shale, which at this point dips northeast at an angle of about 15°. The gravel stratum dips gently toward the south, and is overlain by soil, which varies from three to five feet in thickness, growing thicker toward the south. This layer is also exposed at the top of the sea-cliff near *D*, and at many places along the top of the cliff from *D* to Timm's Point. This formation is exceptionally well developed on the sides of the ravine which cuts the bluff at Crawfish George's, showing a thickness of three feet, very fossiliferous, and, in some places, hardened by calcareous cement. The deposit at Crawfish George's is mentioned by Ashley,[1] who refers it to the Pliocene.

---

[1] Neocene of the Santa Cruz Mountains. By Geo. H. Ashley. Proc. Cal. Acad. Sci., 2nd Ser., Vol. V, 1894, p. 341.

LIST OF FOSSILS COLLECTED AT CRAWFISH GEORGE'S.

PELECYPODA.

Angulus buttoni
Anomia lampe
Cardium corbis
Chama pellucida
Cryptomya californica
Cumingia californica
Diplodonta orbella
Donax lævigata
Glycymeris barbarensis
Glycymeris septentrionalis
Lævicardium substriatum
Lazaria subquadrata
Leda taphria
Lucina acutilineata
Lucina californica
Lucina nuttalli
Lyonsia californica
Macoma inquinata
Macoma nasuta
Macoma secta
Mactra catilliformis
Mactra falcata
Metis alta
Mytilus edulis
Ostrea lurida
Pecten caurinus
Pecten hastatus
Pecten latiauritus
Pecten var. *monotimeris*
Pecten ventricosus
Periploma argentaria
Petricola carditoides
Pholadidea penita
Platyodon cancellatus
Pododesmus macroschisma
Saxidomus aratus
Solen rosaceus
Solen sicarius
Tagelus californianus
Tapes staminea
Tapes tenerrima
Tellina bodegensis
Tivela crassatelloides
Tresus nuttalli
Venericardia barbarensis
Venus simillima
Venus succincta
Zirphæa gabbi

GASTROPODA.

Acmæa depicta
Acmæa insessa
Acmæa instabilis
Acmæa mitra
Acmæa paleacea
Amphissa corrugata
Amphissa versicolor
Bela fidicula
Bittium asperum
Bittium filosum
Bittium quadrifilatum
Bittium rugatum
Bulla punctulata
Cæcum crebricinctum
Calliostoma canaliculatum
Calliostoma costatum
Calliostoma gemmulatum
Calliostoma tricolor
Certhidea californica
Chlorostoma brunneum
Chlorostoma funebrale
Chlorostoma var. *subapertum*
Chlorostoma gallina
Chlorostoma montereyi
Chlorostoma ligulatum
Chorus belcheri
Chrysodomus rectirostris
Clipidella callomarginata
Columbella gausapata
Columbella var. *carinata*
Columbella tuberosa
Conus californicus
Crepidula dorsata
Crepidula navicelloides
Crepidula rugosa
Crucibulum spinosum
Drillia var. *penicillata*
Drillia torosa
Eulima micans
Fissuridea aspera
Fissuridea murina
Fissurella volcano
Fusus barbarensis
Fusus luteopictus
Fusus robustus
Galerus mammillaris
Isapis fenestrata
Lacuna porrecta
Leptothyra carpenteri
Littorina scutulata
Mangilia angulata
Mangilia var. *pedroana*
Marginella jewetti
Melampus olivaceus
Mitra maura
Monoceros engonatum
Murex festivus
Murex leeanus
Murex trialatus
Nassa cerritensis
Nassa fossata
Nassa mendica
Nassa var. *cooperi*
Nassa perpinguis
Nassa tegula
Natica lewisii
Neverita recluziana
Ocinebra interfossa
Ocinebra lurida
Ocinebra var. *aspera*
Ocinebra var. *cerritensis*
Ocinebra micheli
Ocinebra perita
Ocinebra poulsoni
Olivella biplicata
Olivella intorta
Olivella pedroana
Pachypoma inæquale
Phorcus pulligo
Pleurotoma carpenteriana
Pomaulax undosus
Priene oregonensis
Purpura crispata
Ranella californica
Scala indianorum
Scala tincta
Serpulorbis squamigerus
Spiroglyphus lituella
Siphonalia kellettii
Terebra simplex
Tornatina culcitella
Trophon pedroana
Trophon scalariformis
Turritella cooperi
Turritella jewetti
Volvarina varia

CRUSTACEA.

Balanus concavus

ECHINOIDEA.

Echinarachnius excentricus

SCAPHOPODA.

Dentalium semipolitum
Dentalium indianorum
Dentalium hexagonum

The fauna of Crawfish George's consists of one hundred and fifty-three species, of which forty-eight are pelecypods, one hundred are gastropods, three are scaphopods, one is an echinoderm, and one is a crustacean. It is similar to the upper fauna of the San Pedro bluff, with the exception that it affords a few species common in the lower San Pedro series that are not found in the upper beds at any other locality. Another noticeable fact is the great preponderance in numbers of gastropods over pelecypods. The fauna seems to be that of a rocky beach.

All along the cliff, from Crawfish George's to Timm's Point, the gravel lies unconformably in disconnected masses on the Miocene shale, and is covered by soil varying in depth from three to ten feet. From Timm's Point to the north along the bluff this formation is not exposed until a point is reached a little north of the railway cut. Here the typical gravel of the upper San Pedro series rests unconformably upon the lower San Pedro gray sand, and is overlain by a layer of soil. The upper San Pedro gravel (see diagram *D*, Plate XXII) again outcrops in the bluff north of the San Pedro Valley, but is covered in this bluff by a sandy stratum between it and the soil. This gravel stratum runs along the bluff near the surface until it reaches a point about two hundred yards north of the valley, where it suddenly dips at an angle of 45° for eight feet, resting all the while on the eroded surface of the lower San Pedro strata. Again changing its dip to normal, it disappears under the detritus at the mouth of a short ravine. The unconformable position of the upper gravel on the lower gray sand is very apparent a few yards south of the ravine, where fragments of the lower San Pedro strata are found in the upper gravel. After the deposition of the lower San Pedro beds there came a period of uplift, during which they were eroded; then came a period of depression, during which the upper San Pedro beds were deposited on the eroded surface of the lower series.

A heterogeneous series of strata, composed of alternating beds of sand and gravel, occurs above the gravel stratum at the ravine and to the north of it. These overlying beds dip gently to the north, but the series does not decrease in thickness to the north for the reason that other strata begin near the top of the bluff, and thus make a nearly horizontal surface to the top of the series, which is overlain by soil to the thickness of from two to ten feet. The lower strata along this bluff are of fine sand, fossiliferous in places. Near the top of the bluff, however, the strata are composed of coarse material, a distinct layer of gravel cemented with lime and containing many well preserved fossils forming the top layer. This top stratum first appears at the top of the bluff about one hundred feet south of the ravine. From this point south of the ravine it can be traced north along the bluff near the top, around the north end of the bluff, and back again on the west side of this promontory for several hundred feet. About six feet below the top gravel stratum is another layer rich in fossils. The beds below these last two are sand and gravel deposits of varying composition, nearly all, however, fossiliferous. Some of these lower strata show sand-dune bedding, while others are horizontal. This alternation of bedding would indicate a period of alternating conditions of elevation and depression during the beginning of the epoch in which the upper San Pedro beds were deposited. The same sequence of strata as in the north end of the bluff occurs across the little valley to the west. The strata extend toward the west, but just how far it is not possible to determine. All the fossils labeled "San Pedro" and "Lumber yard" are from the upper San Pedro strata in this locality, and many fine specimens have been obtained during the past few years. A great many shiploads of material have been hauled away from the bluffs as ballast by the coaling vessels docked at the port of San Pedro.

The uppermost gravel stratum of the upper San Pedro series appears to be laid down nearly horizontally and almost continuously over the whole of the lower or fifty-foot terrace of San Pedro Hill.

The following species from the type locality of the upper San Pedro series were collected at the north end of the San Pedro bluff, near the lumber yard, one-half mile north of the valley:

LIST OF FOSSILS FROM THE NORTH END OF THE SAN PEDRO BLUFF.

(P indicates species found living at San Pedro; N indicates species found living only north of San Pedro; S indicates species found living only south of San Pedro; E indicates extinct species or those not known as living.)

PELECYPODA.

Amiantis callosa, P
Angulus buttoni, P
Anomia lampe, P
Arca labiata, S
Astarte branneri, E
Cardium corbis, N
Cardium elatum, S
Cardium procerum, S
Cardium quadrigenarium, P
Chama exogyra, P
Chama pellucida, P
Clidiophora punctata, P
Corbula luteola, P
Cryptomya californica, P
Cumingia californica, P
Diplodonta orbella, P
Diplodonta sericata, S
Donax californica, P
Donax lævigata, P
Glycymeris barbarensis, E
Glycymeris septentrionalis, N
Hinnites giganteus, P
Lævicardium substriatum, P
Lazaria subquadrata, P
Leda taphria, P
Lucina acutilineata, P
Lucina californica, P
Lucina nuttalli, P
Lucina tenuisculpta, P
Lyonsia californica, P
Macoma indentata, P
Macoma inquinata, P
Macoma nasuta, P
Macoma var. *kelseyi*, S
Macoma secta, P
Mactra californica, P
Mactra catilliformis, P
Mactra exoleta, S
Mactra falcata, P
Mactra hemphilli, E
Metis alta, P
Modiola recta, P
Mytilus edulis, P
Nucula suprastriata, N
Ostrea lurida, P
Panopea generosa, P
Pecten dentatus, S
Pecten latiauritus, P
Pecten var. *fragilis*, E
Pecten var. *monotimeris*, P
Pecten newsomi, E
Pecten subnodosus, S
Pecten ventricosus, P
Periploma argentaria, P
Petricola carditoides, P
Petricola denticulata, S
Pholadidea penita, P
Platyodon cancellatus, P
Pododesmus macroschisma, P
Psammobia edentula, ?
Psephis tantilla, N
Sanguinolaria nuttalli, P
Saxidomus aratus, P
Semele decisa, P
Semele pulchra, P
Siliqua lucida, P
Siliqua var. *nuttalli*, N
Solen rosaceus, P
Solen sicarius, P
Tagelus californianus, P
Tapes laciniata, P
Tapes staminea, P
Tapes tenerrima, P
Tellina bodegensis, S
Tellina rubescens, S
Tivela crassatelloides, P
Tresus nuttalli, P
Venericardia barbarensis, P
Venus fluctifraga, P
Venus gnidia, S
Venus neglecta, S
Venus simillima, P
Venus succincta, P
Yoldia cooperi, P
Zirphæa gabbi, E

GASTROPODA.

Acmæa insessa, P
Acmæa pelta, P
Acmæa spectrum, P
Actæon punctocælata, P
Actæon traskii, S
Amphissa corrugata, P
Amphissa versicolor, P
Bittium asperum, P
Bittium filosum, P

Bittium quadrifilatum, P
Bittium rugatum, P
Bittium williamsoni, ?
Bulla punctulata, S
Bulla quoyi, P
Cæcum californicum, P
Cæcum crebricinctum, P
Calliostoma annulatum, P
Calliostoma canaliculatum, P
Calliostoma costatum, P
Calliostoma gemmulatum, P
Calliostoma tricolor, P
Cancellaria cooperi, P
Cancellaria crawfordiana, P
Cancellaria tritonidea, E
Cerithidea californica, P
Chlorostoma aureotinctum, P
Chlorostoma funebrale, P
Chlorostoma var. *subapertum*, P
Chlorostoma gallina, P
Chlorostoma montereyi, P
Chlorostoma var. *ligulatum*, P
Chorus belcheri, P
Clathurella conradiana, E
Clipidella bimaculata, N
Clipidella callomarginata, P
Columbella chrysalloidea, P
Columbella gausapata, P
Columbella var. *carinata*, P
Columbella minima, E
Columbella var. *præcursor*, S
Columbella tuberosa, P
Conus californicus, P
Coralliophila nux, S
Crepidula aculeata, P
Crepidula adunca, P
Crepidula navicelloides, P
Crepidula onyx, S
Crepidula rugosa, P
Crucibulum spinosum, P
Cylichna alba, P
Drillia hemphilli, S
Drillia inermis, P
Drillia johnsoni, E
Drillia var. *penicillata*, P
Drillia pudica, S
Drillia torosa, P
Erato columbella, P
Eulima hastata, S
Eulima micans, P
Eupleura muriciformis, S
Eupleura var. *curta*, E
Fissuridea aspera, P
Fissuridea inæqualis, S
Fissuridea murina, P
Fissurella volcano, P
Fusus barbarensis, E
Fusus luteopictus, P
Fusus robustus, P
Galerus mammillaris, P
Haminea virescens, P
Helix sp. indet., ?
Isapis fenestrata, P
Ishnochiton regularis, P
Lacuna compacta, N
Lacuna porrecta, N
Lacuna solidula, P
Leptothyra carpenteri, P
Littorina planaxis, P
Littorina scutulata P
Macron kellettii, S
Mopalia ciliata, P
Mangilia hooveri, E
Mangilia striosa, P
Margarita var. *knechti*, E
Margarita var. *pedroana*, E
Marginella jewetti, P
Melampus olivaceus, P
Mitra maura, P
Monoceros engonatum, P
Monoceros lapilloides, P
Murex festivus, P
Murex foliatus, N
Murex leeanus, S
Murex monoceros, S
Murex trialatus, P
Nassa californiana, P
Nassa cerritensis, E
Nassa fossata, P
Nassa insculpta, C
Nassa mendica, P
Nassa var. *cooperi*, P
Nassa perpinguis, P
Nassa tegula, P
Nassa var. *hooveri*, S
Natica lewisii, P
Neverita recluziana, P
Ocinebra foveolata, P
Ocinebra interfossa, P
Ocinebra var. *aspera*, P
Ocinebra cancellina, S
Ocinebra perita, P
Ocinebra poulsoni, P
Odostomia tenuis, P
Olivella biplicata, P
Olivella intorta, P
Olivella pedroana, P
Opalia borealis, P
Pachypoma inæquale, P
Paludestrina curta, E
Paludestrina stokesi, E
Phasianella compta, P
Pisania fortis, E
Planorbis tumidus, S
Planorbis vermicularis, N
Pleurotoma carpenteriana, P
Pleurotoma cooperi, E
Pleurotoma perversa, N
Pleurotoma tryoniana, P
Pomaulax undosus, P
Priene oregonensis, P
Puncturella cucullata, N
Purpura crispata, N
Purpura saxicola, P
Pyramidella var. *variegata*, S
Ranella californica, P
Rissoa acutelirata, S
Scala bellastriata, P
Scala crebricostata, P
Scala hemphilli, E
Scala hindsii, P
Scala indianorum, P
Scala tincta, P
Serpulorbis squamigerus, P
Siphonalia kellettii, P
Spiroglyphus lituella, P
Terebra simplex, P
Tornatina cerealis, P
Tornatina culcitella, P
Trivia californica, P
Triton gibbosus, S
Trophon multicostatus, N
Turbonilla aurantia, P
Turbonilla laminata, P
Turbonilla lowei, E
Turbonilla stearnsii, S
Turbonilla subcuspidata, S
Turbonilla tenuicula, P
Turritella cooperi, P
Turritella jewetti, E
Vitrinella williamsoni, P
Volvarina varia, P

CRUSTACEA.

Balanus concavus, P

SCAPHOPODA.

Dentalium hexagonum, P
Dentalium pseudohexagonum. ?
Dentalium semipolitum, S

ECHINOIDEA.

Echinarachnius excentricus, P

PISCES.

Urolophus halleri, ?

Resumé.

Total number of species		252
Pelecypoda		85
Gastropoda		161
Scaphopoda		3
Echinoidea		1
Crustacea		1
Pisces		1
Living at San Pedro		172
Percentage of fauna	68.2	
Living only north of San Pedro		15
Percentage of fauna	6.1	
Living only south of San Pedro		36
Percentage of fauna	14.2	
Extinct species		24
Percentage of fauna	9.5	
Questionable		4
Percentage of fauna	1.6	

The fauna of the upper San Pedro series as afforded by the beds near the lumber yard is of a character more nearly resembling that found living at the present time on the coast two or three hundred miles further south. Not only is there a large percentage of species now living only south of San Pedro, but of the species living at San Pedro many are southern forms. Several of the northern forms remained during the period of deposition of the upper San Pedro series, but in greatly diminished numbers. Of the extinct forms most are new species or varieties which may be found upon a more extended examination to be living. Faunal evidence leads to the conclusion, therefore, that the climatic conditions on the coast near San Pedro during the period of deposition of the upper San Pedro series were as warm, if not warmer, than those of the present time. The change from the boreal conditions of the upper Pliocene epoch to the tropical or semitropical conditions of the Pleistocene was not sudden, but took place rather gradually, as is shown by the transition fauna of the lower San Pedro deposits.

The upper San Pedro stage described in this paper is separated from the lower San Pedro deposits for the following reasons: First, there is an unconformity between these upper beds and the underlying formations at all of the localities examined. Secondly, the upper San Pedro beds differ lithologically from the lower San Pedro strata; the former being largely gravels, while the latter are of gray sand. Thirdly, the difference in the fossils of the two horizons is very marked. Many found in the lower series are not found in the upper, and many of the species in the latter are never found in the former. Fourthly, the upper series has a semi-tropical fauna, while that of the lower series approaches the semi-boreal.

The upper San Pedro beds do not represent the top of the Pleistocene. The fauna of these upper beds, although having many species in common with the living fauna of the same locality, is still quite distinct. This would suggest a period of considerable length since the deposition of the strata. The number of distinctly southern forms living at San Pedro during the period of deposition of the upper beds also shows that there has probably been a change in climatic conditions since that time. A raised beach unconformable with the upper San Pedro strata at Deadman Island shows that there have been orographic movements since the upper San Pedro beds were deposited. All of this evidence, then, leads to the conclusion that there has been a sufficient lapse of time since the deposition of the upper San Pedro strata, to admit of marked faunal and orographic changes.

The upper San Pedro series is well developed on Los Cerritos Hill, where the typical fossiliferous gravels of the upper San Pedro formation overlie unconformably the brown, tilted sandstones which form the major portion of that hill. A little above *H* (diagram *E*, Plate XXIII), the gravel stratum has a dip of 4° due south. Below the gravel stratum is a thin bed of sand, which is also very fossiliferous. At *G* the gravel stratum is only a few feet below the surface of the hill, but near the top of the hill this stratum is covered by a deeper deposit of sands and sandy soil. The dip of the stratum at *K* is N. 85° W. at an angle of from 12° to 15°. At *K* the gravel is overlain by a deposit of fine, unfossiliferous sand four feet thick.

At all the localities on Los Cerritos Hill where the upper San Pedro beds are exposed, the underlying formation is a series of sands and conglomerates. No fossils were obtained in the underlying series of rocks, but they are probably of the lower San Pedro series.

It will be noticed, on looking at the contours on diagram *E*, Plate XXIII, and observing the dips at the different places, that the dip of the gravel stratum conforms very nearly to the slope of the hill. There is a fault at *H*, which cuts the upper San Pedro stratum. The sand deposits above the gravels in a few places are probably what is left of layers of sand which once covered the whole area. On the flanks of the hill, both to the northwest, where the Los Angeles Terminal Railway cuts the ridge, and toward the south, where the ocean has exposed the beds, sands overlie or replace the gravel stratum. This fossiliferous upper San Pedro stratum is at no place on Los Cerritos Hill more than a few feet thick. W. S. T. Smith[1] thinks that perhaps this hill is wave built, but a careful examination shows that it is the result of an orogenic movement which has taken place since the lower San Pedro beds were deposited there. This is shown by the contortion of the lower formation, and by the steep dips of the uppermost layers, which conform almost exactly with the slope of the hill. This orogenic movement has taken place since the upper San Pedro series was deposited, and is evidence in favor of the theory that the upper San Pedro beds are at least older than the latest Pleistocene.

LIST OF SPECIES COLLECTED IN THE UPPER SAN PEDRO BEDS AT LOS CERRITOS.

PELECYPODA.

Aligena cerritensis
Amiantis callosa
Angulus buttoni
Anomia lampe
Astarte branneri
Cardium corbis
Cardium elatum
Cardium procerum
Cardium quadrigenarium
Chama exogyra
Chama pellucida
Corbula luteola
Cryptomya californica
Donax lævigata
Glycymeris barbarensis
Glycymeris septentrionalis
Hinnites giganteus
Lævicardium substriatum

---

[1] Topographic Study of the Islands of Southern California. By W. S. T. Smith. Bull. Dept. Geol., Univ. of Cal., Vol. II, 1900, p. 224.

Leda taphria
Lithophagus plumula
Lucina californica
Lucina nuttalli
Macoma indentata
Macoma inquinata
Macoma nasuta
Macoma var. *kelseyi*
Macoma secta
Mactra catilliformis
Mactra falcata
Metis alta
Modiola fornicata
Modiola recta
Nucula suprastriata
Ostrea lurida
Panopea generosa
Pecten latiauritus
Pecten var. *fragilis*
Pecten var. *monotimeris*
Pecten newsomi
Pecten ventricosus
Periploma argentaria
Petricola carditoides
Petricola denticulata
Pholadidea penita
Platyodon cancellatus
Psephis tantilla
Sanguinolaria nuttalli
Saxidomus aratus
Semele decisa
Semele pulchra
Siliqua lucida
Solen sicarius
Tagelus californianus
Tapes lacineata
Tapes staminea
Tapes tenerrima
Tellina bodegensis
Tellina idæ
Tivela crassatelloides
Tresus nuttalli
Venus neglecta
Venus simillima
Venus succincta
Zirphæa gabbi

GASTROPODA.

Acmæa insessa
Acmæa pelta
Amphissa corrugata
Amphissa versicolor
Bittium quadrifilatum
Bittium rugatum
Bulla punctulata
Cæcum californicum
Cæcum crebricinctum
Calliostoma canaliculatum
Calliostoma costatum
Calliostoma gemmulatum
Calliostoma tricolor
Cerithidea californica
Chlorostoma funebrale
Chlorostoma var. *subapertum*
Chlorostoma var. *ligulatum*
Chorus belcheri
Clipidella bimaculata
Clipidella callomarginata
Columbella gausapata
Columbella var. *carinata*
Columbella tuberosa
Conus californicus
Crepidula adunca
Crepidula dorsata
Crepidula navicelloides
Crepidula onyx
Crepidula rugosa
Crucibulum spinosum
Drillia cancellata
Drillia hemphilli
Drillia inermis
Drillia var. *penicillata*
Drillia torosa
Eulima micans
Fissuridea aspera
Fissuridea inæqualis
Fissuridea murina
Fissurella volcano
Fusus luteopictus
Hipponyx cranioides
Lacuna compacta
Lacuna porrecta
Leptothyra bacula
Littorina scutulata
Lucapina crenulata
Mangilia angulata
Mangilia interlirata
Mangilia striosa
Margarita var. *pedroana*
Melampus olivaceus
Monoceros engonatum
Murex festivus
Nassa californiana
Nassa cerritensis
Nassa fossata
Nassa mendica
Nassa var. *cooperi*
Nassa perpinguis
Nassa tegula
Natica lewisii
Neverita recluziana
Ocinebra var. *aspera*
Ocinebra var. *cerritensis*
Ocinebra poulsoni
Olivella biplicata
Olivella intorta
Olivella pedroana
Pleurotoma perversa
Ranella californica
Scala hindsii
Scala indianorum
Scala tincta
Serpulorbis squamigerus
Sigaretus debilis
Siphonalia kellettii
Spiroglyphus lituella
Taranis strongi
Terebra simplex
Tornatina culcitella
Trophon cerritensis
Turbonilla aurantia
Turbonilla crebrifilata
Turbonilla laminata
Turbonilla lowei
Turbonilla similis
Turbonilla stearnsii
Turbonilla subcuspidata
Turbonilla tenuicula
Turbonilla tridenta
Turritella cooperi
Volvaria varia

CRUSTACEA.

Balanus concavus

SCAPHOPODA.

Dentalium hexagonum

ECHINOIDEA.

Echinarachnius excentricus

This fauna consists of one hundred and sixty species, of which sixty-four are pelecypods, ninety-two are gastropods, one is a scaphopod, one is a crustacean, and one is an echinoderm. It is similar to the upper San Pedro fauna of the beds at the north end of the San Pedro bluff; and has even a more southern character than that fauna. The great preponderance of pelecypods over gastropods as regards the number of individuals is noteworthy in the Los Cerritos deposits. It is such a fauna as would be found on a low, sandy coast.

There is an extensive exposure of upper San Pedro strata in the bluff to the south and southeast of Long Beach. A typical section of the bluff is represented by the section exposed at *B* (diagram *E*, Plate XXIII), about one and one-half miles east of the Long Beach wharf. The sequence of the beds is as follows :

Soil, grading into unstratified brown sand	12 feet
Thin beds of light gray sand	8 feet
White wind-bedded sand	15 feet
Brown sand, with horizontal bedding	6 feet
Total thickness	41 feet

All of the strata from this point west to *A* (diagram *E*, Plate XXIII), the end of the bluff, dip gently westward, the lower strata disappearing successively under the level of the beach. The fossils in this series occur only in local deposits, most of them being found in lens-shaped pockets in the white sand layer. There is a very fossiliferous deposit at *E*, which extends for three hundred feet along the base of the cliff. At *B* (diagram E, Plate XXIII), also, there is a small deposit of sand containing only *Ostrea lurida*. It is probable that for the most part these strata were deposited during a period of sand-dune and estuarine conditions along this part of the coast. The dominating shells in these deposits are *Ostrea lurida*, *Cryptomya californica*, *Tagelus californianus*, and other forms which inhabit lagoons and shallow waters. The following fossils were obtained from the fossiliferous bed at the base of the bluff at *E*, southeast of Long Beach.

LIST OF FOSSILS FROM THE BEDS SOUTHEAST OF LONG BEACH.

Anomia lampe
Balanus concavus
Crepidula rugosa
Columbella var. *carinata*
Cardium procerum
Cardium quadrigenarium
Crucibulum spinosum
Chione simillima
Chlorostoma funebrale
Cryptomya californica
Conus californicus
Donax lævigata
Dentalium hexagonum
Drillia var. *penicillata*
Fissuridea inæqualis
Glycymeris septentrionalis
Lucina nuttalli
Lucina californica
Littorina scutulata
Lunatia lewisii
Leda taphria
Monoceros engonatum
Macoma secta
Macoma nasuta
Neverita recluziana
Nassa perpinguis
Nassa cerritensis
Nassa tegula
Nassa mendica
Nassa var. *cooperi*
Nassa fossata
Nassa californiana
Ostrea lurida
Olivella biplicata
Olivella pedroana
Olivella intorta
Pecten ventricosus
Pecten latiauritus
Pecten var. *monotimeris*
Pleurotoma carpenteriana
Pteronotus festivus
Serpulorbis squamigerus
Scala tincta
Terebra simplex
Tagelus californianus
Turritella cooperi
Tellina bodegensis
Tivela crassatelloides
Tapes staminea
Venericardia barbarensis
Zirphæa gabbi

The deposits of Dominguez Hill are probably of upper San Pedro age, although no fossils have been found in them. Lithologically they are similar to the deposits around the base of Los Cerritos Hill.

Raised Beach Formation.—The recently raised beach on the north end of Deadman Island (see diagram *B*, Plate XXII) shows that the period of uplift which followed the deposition of the upper San Pedro beds is not yet finished. This raised beach contains many fossil shells in a perfect state of preservation, all of them retaining their original color, which suggests how recently this uplift has taken place.

List of Fossils from the Raised Beach, North End of Deadman Island.

PELECYPODA.

Cryptomya californica
Donax lævigata
Lævicardium substriatum
Lucina californica
Lucina nuttalli
Macoma inquinata
Macoma nasuta
Macoma secta
Mactra catilliformis
Mactra falcata
Mytiius edulis
Pecten latiauritus
Pecten var. *monotimeris*
Pecten ventricosus
Petricola carditoides
Tapes staminea
Tellina bodegensis

GASTROPODA.

Acmæa spectrum
Acmæa pelta
Bulla nebulosa
Calliostoma canaliculatum
Cerithidea californica
Chlorostoma funebrale
Columbella gausapata
Columbella var. *carinata*
Conus californicus
Crepidula rugosa
Crecibulum spinosum
Drillia var. *penicillata*
Fissurella volcano
Nassa fossata
Nassa var. *cooperi*
Olivella biplicata
Olivella intorta

These species are all found living in the waters adjacent to Deadman Island at the present time, and the raised beach specimens are in nearly as good a state of preservation as the living shells.

5. Post–Pleistocene Deposits.

Overlying the Pleistocene of Deadman Island, and all along the San Pedro terrace, is soil containing many shells, in fact, in places it is made up almost entirely of shells. These are the remains of ancient Indian kitchen-middens. Ashley[1] describes as Quaternary a layer of shells found in the lower terrace of San Pedro Hill. After examining the fossils collected by him, and also visiting the locality from which they came, the writer is convinced that these deposits are simply the shells brought there by the Indians, for the association of species is not such as would be found at any one place on the beach; rocky shore and lagoon shells being found in about equal quantities. At every place where these shell deposits in the soil have been examined by the writer they have been found to contain pieces of charcoal, bones of mammals, and other evidences of refuse heaps. These kitchen-middens are common at many places along the coast. Those at Port Harford are over six feet in thickness and have been mistaken by some collectors for Pleistocene strata.

The shells in these kitchen waste heaps are of a kind that would be used for food, and include such species as *Haliotis cracheroidii*, *Pecten æquisulcatus*, *Chione succincta*, *Tivela crassatelloides*, *Tapes staminea*, *Saxidomus aratus*, etc. All of the specimens of *Haliotis* so far recorded from the Pleistocene, with the exception of one

---

[1] The Neocene Stratigraphy of the Santa Cruz Mountains of California. By George H. Ashley. Proc. Cal. Acad. Sci., 2d Ser., Vol. V, 1895, pp. 353-356.

Haliotis fulgens found by the writer in the upper San Pedro conglomerate of Deadman Island, and another in the Pleistocene at Spanish Bight, San Diego, have been taken from these Indian kitchen-middens.

6. ALPHABETIC LIST SHOWING THE DISTRIBUTION OF SPECIES IN THE VICINITY OF SAN PEDRO.

In order to avoid any mistake, a brief description of the locality represented by each column in the following list is here given.

The second column, marked "Deadman Island" under upper San Pedro series, refers to the gravel stratum which extends across Deadman Island about six feet below the surface, and which is shown as the upper San Pedro series in diagram *B*, Pl. XXII. (See also diagram *E*, Pl. XXIII.)

The third column, marked "Lumber Yard," refers to the sand and gravel deposits at the north end of the San Pedro bluff; these beds are designated as upper San Pedro series in diagram *D*, Pl. XXII.

The fourth column refers to Los Cerritos Hill, which is shown on diagram *E*, Pl. XXIII, and diagram *C*, Pl. XXII. The fossils reported in this column come from the gravel and sand strata at the localities *H* and *K* on that hill.

The fifth column, designated as "Crawfish George's," refers to the deposits on the northeast side of the mouth of the ravine which empties into the ocean at Crawfish George's. (See diagram *E*, Pl. XXIII.)

The sixth column, marked "Deadman Island" under lower San Pedro series, refers to the gray sand deposits lying between the Pliocene and upper San Pedro gravel strata; this deposit is designated as lower San Pedro series in diagram *B*, Pl. XXII.

The seventh column, designated as "San Pedro Bluffs," refers to the lower San Pedro strata which lie above the Pliocene on the south and below the upper San Pedro series on the north, in the water front bluff east of San Pedro; these deposits are designated as lower San Pedro series in diagram *D*, Pl. XXII.

Column eight, marked "Deadman Island" under Pliocene, refers to the brown sand, "Cryptodon beds," and contact stratum of Deadman Island; these deposits are designated as Pliocene in diagram *B*, Pl. XXII.

The ninth column, marked "Timm's Point" under Pliocene, refers to the brown sand deposits of Timm's Point and between that point and the middle of the railroad cut and grade up the bluff in the southeastern portion of San Pedro; these deposits are designated as Pliocene in diagram *D*, Pl. XXII.

ALPHABETIC LIST SHOWING THE DISTRIBUTION OF SPECIES IN THE VICINITY OF SAN PEDRO.*

(E indicates species which are extinct; X indicates species living at San Pedro; S indicates species living only south of San Pedro; N indicates species living only north of San Pedro; C indicates species living only at Catalina Island; R stands for rare; M stands for medium abundant; C stands for common.)

	Living.	Pleistocene.						Pliocene.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
PELECYPODA.									
Aligena cerritensis, sp. nov.	E			R					
Amiantis callosa Conrad	X		R	C					
Angulus buttoni Dall	X	R	R	R	R	M	R		
Anomia lampe Gray	X		C	C	M	R	R		
Arca labiata Sowerby	S		R						
Astarte (Crassinella) branneri, sp. nov.	E		M	M					
Bornia retifera Dall	N					R			
Callista subdiaphana Carpenter	N							C	C
Callista subdiaphana var. *pedroana*, var. nov.	E					R			
Callista newcombiana Gabb	X	R	R						
Cardium corbis Martyn	N	R	M	M	M	M	M		
Cardium elatum Sowerby	S		R	R					
Cardium procerum Sowerby	S		C	C		R			
Cardium quadrigenarium Conrad	X		C	C					
Chama exogyra Conrad	X		R	R					
Chama pellucida Sowerby	X	R	R	R	R	M		C	
Clidiophora punctata Conrad	X		R			R			
Cooperella subdiaphana Carpenter	X					R			
Corbula luteola Carpenter	X		R	M		R	M	R	
Cryptomya californica Conrad	X	R	C	M	R	M	M		
Cumingia californica Conrad	X	R	R		R	R	C	R	
Diplodonta orbella Gould	X		R		R	R			
Diplodonta serricata Reeve	S		C						
Donax californica Conrad	X		R			R	R		
Donax lævigata Deshayes	X	M	C	C	M	R	M		
Glycymeris barbarensis Conrad	E	R	C	R	R				

---

* This list has been kept open until the time for sending the manuscript to press, and contains a few species which are not given in the general discussion, although the descriptions of all species mentioned are given in Part II

	LIVING.	PLEISTOCENE.						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Glycymeris septentrionalis Middendorf	N	R	C	R	R				
Hinnites giganteus Gray	X	R	M	R	R		R		
Kellia laperousii Deshayes	X					R	R	R	
Kellia suborbicularis Montague	X					R	R		
Kennerlia bicarinata Carpenter	C					R			
Kennerlia filosa Carpenter	N					R			
Laevicardium substriatum Conrad	X	R	C	R	R	R	R		
Lazaria subquadrata Carpenter	X		C		R	R	R		
Leda fossa Baird	N					M			
Leda hamata Carpenter	X					R			
Leda minuta var. *praecursor*, var. nov.	N					R	R		
Leda taphria Dall	X	R	M	M	R	C	R	C	R
Lima dehiscens Conrad	X					R			
Lithophagus plumula Hanley	X			R					
Lucina acutilineata Conrad	X	R	R		R	C	C	C	C
Lucina californica Conrad	X	R	R	R	R	C	C	C	
Lucina nuttalli Conrad	X	C	C	C	M	C	C		
Lucina tenuisculpta Carpenter	X		R						
Lyonsia californica Conrad	X	R	R		R	M	C	C	
Macoma calcarea Gmelin	N					M		M	
Macoma indentata Carpenter	X		R	R					
Macoma inquinata Deshayes	X	R	C	C	R	M	C	C	
Macoma nasuta Conrad	X	M	C	M	M	C			
Macoma nasuta var. *kelseyi* Dall	S		M	M			M		
Macoma secta Conrad	X	R	C	R	R	R	R		
Macoma yoldiformis Carpenter	X				R	R			
Mactra californica Conrad	X		M						
Mactra (*Spisula*) *catilliformis* Conrad	X	C	C	C	R				
Mactra exoleta Gray	S		R						
Mactra (*Spisula*) *falcata* Gould	X	M	C	C	M	R	R		
Mactra hemphilli Dall	S		R						
Metis alta Conrad	X	R	R	C	R	R			
Modiola fornicata Carpenter	N			R		R			
Modiola recta Conrad	X	R	R	R		R			
Mœrella salmonea Carpenter	N					C			
Mytilus edulis Linnæus	X	R	R		R	R			

	Living.	Pleistocene.						Pliocene.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Mytilimeria nuttalli Conrad	X					R	R	R	
Neæra pectinata Carpenter	X					R			
Nucula (Acila) castrensis Hinds	X					R	R	C	R
Nucula suprastriata Carpenter	N		C	C		R	R		
Ostrea lurida Carpenter	X		C	R	R	R	R		
Panomya ampla Dall	N					R		R	
Panopea generosa Gould	X	R		R		R		R	
Pecten (Patinopecten) caurinus Gould	N		R		R	M		C	C
Pecten (Pecten) dentatus Sowerby	S								
Pecten (Chlamys) hastatus Sowerby	X				R	R		M	
Pecten (Chlamys) hericeus Gould	N					R		M	
Pecten (Chlamys) hericeus var. *strategus* Dall	N					R			
Pecten (Chlamys) jordani, sp. nov	E					R		M	
Pecten latiauritus Conrad	X	M	C	C	R	R	R		
Pecten latiauritus var. *fragilis*, var. nov	E		R	R					
Pecten latiauritus var. *monotimeris* Conrad	X	R	R	M	R	R	R		
Pecten (Plagioctenium) newsomi, sp. nov	E		R	R					
Pecten stearnsii Dall	E							R	
Pecten (Nodipecten) subnodosus Sowerby	S	R	R						
Pecten (Plagioctenium) ventricosus Sowerby	X	M	C	M	R				
Pecten (Plagioctenium) ventricosus Sowerby var.	E		R						
Periploma argentaria Conrad	X	R	R	R	R				
Petricola carditoides Conrad	X	M	M	R	M	R			
Petricola (Petricolaria) cognata C. B. Adams	X	R	R						
Petricola denticulata Sowerby	S		R	C		R			
Pholadidea penita Conrad	X	M	M	M	M			R	
Platyodon cancellatus Conrad	X	R	R	R	R				
Pododesmus (Monia) macroschisma Deshayes	X	R	R		R				
Protocardia centifilosa Carpenter	X					R		C	R
Psammobia edentula Gabb	?		R						
Psephis salmonea Carpenter	C					R	R		
Psephis tantilla Gould	N	R	R	R		M	R		
Ræta undulata Gould	X					R			
Rupellaria lamellifera Conrad	X	R							
Sanguinolaria nuttalli Conrad	X		M	R					
Saxidomus aratus Gould	X	C	C	C	R	R			

	LIVING.	PLEISTOCENE.						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro	Deadman Island	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Semele decisa CONRAD	X	M	M	C			M		
Semele pulchra SOWERBY	X		R	R					
Semele pulchra var. *montereyi*, var. nov.	N					R			
Septifer bifurcatus CONRAD	X					R			
Siliqua lucida CONRAD	X		M	M		R	M		
Siliqua patula var. *nuttalli* CONRAD	N		R						
Solen rosaceus CARPENTER	X	R			R	R	R		
Solen sicarius GOULD	X	R	R	R	R	C	M	C	M
Tagelus californianus CONRAD	X	C	C	C	M				
Tapes laciniata CARPENTER	X		R	M					
Tapes staminea CONRAD	X	C	C	C	M	R	M		
Tapes tenerrima CARPENTER	X	R	R	R	R				
Tellina bodegensis HINDS	X	R	C	C	R	M	M		
Tellina idae DALL	X			R					
Tellina rubescens HANLEY	S		R						
Thracia trapezoides CONRAD	E							R	C
Thyasira bisecta CONRAD	N							C	R
Thyasira gouldii PHILIPPI	X							R	R
Tivela crassatelloides CONRAD	X	R	C	M	R	R			
Tresus nuttalli CONRAD	X	C	C	R	R				
Venericardia barbarensis STEARNS	X		R		R	R		C	M
Venericardia ventricosa GOULD	N					R		C	C
Venus (Chione) fluctifraga SOWERBY	X		R						
Venus (Chione) gnidia BRODERIP & SOWERBY	S		R						
Venus (Chione) neglecta SOWERBY	S		R	R					
Venus (Chione) simillima SOWERBY	X	M	C	C	R	R		R	
Venus (Chione) succincta VALENCIENNES	X	C	C	C	C				
Verticordia novemcostata ADAMS & REEVE	X					R			
Yoldia cooperi GABB	X		R						
Yoldia scissurata DALL	X					R			
Zirphaea gabbi TRYON	X	R	M	R	M				

	LIVING.	PLEISTOCENE.						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
GASTROPODA.									
Acmæa depicta GOULD	S				R				
Acmæa insessa HINDS	X	R	M	R	M	M	M	M	
Acmæa instabilis GOULD	N				R				
Acmæa mitra ESCHSCHOLTZ	X				C				
Acmæa paleacea GOULD	X				C				
Acmæa pelta ESCHSCHOLTZ	X		R	M		R			
Acmæa spectrum (NUTTALL) REEVE	X	R	M			R			
Actæon (Rictaxis) punctocælata CARPENTER	X		R			R	R		
Actæon traskii STEARNS	?		R						
Admete gracilior CARPENTER	E					R			
Amphissa corrugata REEVE	X		R	R	R	R		C	
Amphissa ventricosa, sp. nov	E					R			
Amphissa versicolor DALL	X	R	R	R	C	R			
Bela fidicula GOULD	N				R	R		R	
Bela sanctæ-monica sp. nov	E					R			
Bittium asperum GABB	X		R		R	M		C	R
Bittium californicum DALL & BARTSCH	E					R			
Bittium filosum GOULD	N		C		R	M	M		
Bittium quadrifilatum CARPENTER	X	R	R	R	M	M	M		
Bittium rugatum CARPENTER	X		C	C	C	C	C		
Bittium williamsoni, sp. nov	?		R						
Bulla punctulata A. ADAMS	S	R	C	C	M				
Bulla quoyi GRAY	X		R						
Cæcum californicum DALL	X		R	R		C	M		
Cæcum crebricinctum CARPENTER	X		R	R	R	R	C		
Cæcum magnum STEARNS	?					R	R		
Calliostoma annulatum MARTYN	X		M						
Calliostoma caniculatum MARTYN	X	R	M	C	C	M	M	R	
Calliostoma costatum MARTYN	X		M	R	R	R	R		
Calliostoma gemmulatum CARPENTER	X		M	R	R				
Calliostoma tricolor GABB	X		M	R	R		C	R	
Cancellaria cooperi GABB	X		R						
Cancellaria crawfordiana DALL	S		R						
Cancellaria tritonidea GABB	E		R						

	LIVING.	PLEISTOCENE						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Cerithidea californica HALDEMANN	X	R	C	R		R	M	R	
Chlorostoma aureotinctum FORBES	X		M						
Chlorostoma brunneum PHILIPPI	X	R			R			R	
Chlorostoma funebrale A. ADAMS	X	R	M	R	C	R	R		
Chlorostoma funebrale var. *subapertum* CARPENTER	X	R	M	R	C	R	R		
Chlorostoma gallina FORBES	X	R	R		R				
Chlorostoma montereyi KIENER	X	R	R		R	R		R	
Chlorostoma (Omphalius) viridulum var. *ligulatum* MENKE	X	R	M	C	C	R	M		
Chorus belcheri HINDS	X		M	R	R				
Chrysodomus, sp. indet.	X							R	
Chrysodomus rectirostris CARPENTER	X				R	M		M	
Chrysodomus tabulatus BAIRD	X					M	R	C	R
Clathurella conradiana GABB	?		R			C	R	C	
Clypidella bimaculata DALL	X		R	R		M	M		
Clypidella callomarginata CARPENTER	X		R	R	R	R	R		
Columbella (Astyris) californiana GASKOIN	X					R	M		
Columbella (Æsopus) chrysalloidea CARPENTER	X		C			R	R		
Columbella (Astyris) gausapata GOULD	X	R	R	R	R	R	R	R	R
Columbella (Astyris) gausapata var. *carinata* HINDS	X	C	C	C	M	M	M	C	M
Columbella (Anachis) minima, sp. nov.	E		R						
Columbella (Æsopus) oldroydi, sp. nov.	E					R			
Columbella solidula var. *præcursor*, var. nov.	S		R						
Columbella (Astyris) tuberosa CARPENTER	X	R	C	R	R	M	R		
Conus californicus HINDS	X	C	C	C	C	M	M	M	M
Coralliophila nux REEVE	S		R						
Crepidula aculeata GMELIN	X					R	M		
Crepidula adunca SOWERBY	X	M	C	M	M	M	M		
Crepidula dorsata BRODERIP	X			R	R	R			
Crepidula grandis MIDDENDORF	X	R							
Crepidula navicelloides NUTTALL	X	M	C	R	M	R	M		
Crepidula onyx SOWERBY	S	R	M	R		R	M		
Crepidula rugosa NUTTALL	X	C	C	C	C	R			
Crucibulum spinosum SOWERBY	X	M	C	M	M		C		
Cryptochiton stelleri MIDDENDORF	X					R		R	

	Living.	Pleistocene.						Pliocene.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Cylichna alba Brown	X		R			M			
Cypræa spadicea Gray	X	R	R						
Cythara branneri, sp. nov.	E					C			
Diastoma, sp. indet	?					R			
Drillia cancellata Carpenter	N			R		M			
Drillia hemphilli Stearns	S		C	M	R	M	R		
Drillia inermis Hinds	X		C	C		R			
Drillia inermis var. *penicillata* Carpenter	X	M	C	C	M	R	M		
Drillia johnsoni, sp. nov.	E		R						
Drillia merriami, sp. nov.	E					R		R	
Drillia montereyensis Stearns	N					R			
Drillia pudica Hinds	S		R						
Drillia torosa Carpenter	X	R	R	R	C	R	R	C	M
Erato columbella Menke	X		R						
Eulima falcata Carpenter	S					R			
Eulima hastata Sowerby	S		R			R			
Eulima micans Carpenter	X		R	M	R	C	M		
Eupleura muriciformis Broderip	S	R	R			R			
Eupleura muriciformis var. *curta*, var. nov	E		R						
Fissuridea aspera Eschscholtz	X	R	R	R	C	R	M		
Fissuridea inæqualis Sowerby	S	R	R	M					
Fissuridea murina (Carpenter) Dall	X	R	R	R	M	R			
Fissurella volcano Reeve	X	M	C	M	C	M	M		
Fusus barbarensis Trask	X	R	R		R	R		C	M
Fusus luteopictus Dall	X	M	M	M	C	R			
Fusus robustus Trask	X	R	R		C				
Fusus rugosus Trask	X					M			
Gadinia reticulata Sowerby	X		R						
Galerus mammillaris Broderip	X		R		R	R	R		
Haliotis fulgens Philippi	X	R							
Haminea virescens Sowerby	X		R						
Helix (*Epiphragmophora*), sp. indet	?		R						
Hipponyx antiquatus Linnæus	X					R		R	
Hipponyx cranioides Carpenter	N	R		R		C	M		
Hipponyx tumens Carpenter	X	R				R	R		

	LIVING.	PLEISTOCENE						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro	Deadman Island	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Isapis fenestrata Carpenter	X	R	M		R	R	C		
Ischnochiton regularis Carpenter	X		R						
Irura terricula (Carpenter) Dall & Bartsch	S					R			
Lacuna compacta Carpenter	X		M	R		R			
Lacuna porrecta Carpenter	X	R	C	R	R	M	M		
Lacuna solidula (Loven) Carpenter	X		R			R			
Lamellaria stearnsii Dall	X					R			
Leptothyra bacula Carpenter	X			R		R			
Leptothyra carpenteri Pilsbry	X		R		R	R	R		
Leptothyra paucicostata Dall	X					R			
Littorina planaxis (Nuttall) Philippi	X		R			R	R	R	
Littorina scutulata Gould	X	R	M	R	R	M	C		
Lucapina crenulata Sowerby	X			R					
Macron kellettii A. Adams	S		R						
Macron lividus A. Adams	X		R						
Mangilia angulata Carpenter	X			R	R	C	M		
Mangilia hooveri, sp. nov	E		R						
Mangilia interfossa var. *pedroana*, var. nov	E				R	R			
Mangilia interlirata Stearns	X			R		R			
Mangilia oldroydi, sp. nov	E					R			
Mangilia painei, sp. nov	E					R			
Mangilia sculpturata Dall	X					C		R	
Mangilia striosa C. B. Adams	X		R	R					
Margarita optabilis var. *knechti*, var. nov	E		R				C		
Margarita optabilis var. *nodosus*, var. nov	E					R	R		
Margarita parcipicta var. *pedroana*, var. nov	E	R	M	R		R	C		
Margarita pupilla Gould	X							R	
Marginella jewettii Carpenter	X	R	R		R	R	M		
Melampus olivaceus Carpenter	X	R	C	R	R	R	M		
Mitra maura Swainson	X	R	R		M		M		
Mitramorpha filosa Carpenter	X					M			
Mitramorpha intermedia, sp. nov	E					M			
Monoceros engonatum Conrad	X	M	C	R	M	R	R		
Monoceros lapilloides Conrad	X		R						
Mopalia ciliata Sowerby	X		R						

	LIVING.	PLEISTOCENE.						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Murex (*Pteronotus*) *festivus* Hinds	X	R	C	M	R	R			
Murex (*Pterohytis*) *foliatus* Martyn	N		R						
Murex (*Pterohytis*) *nuttalli* Conrad	X	R		R	R				
Murex (*Chicoreus*) *leeanus* Dall	S		C		M				
Murex (*Cerostoma*) *monoceros* Sowerby	S		C						
Murex trialatus Sowerby	X	R	M		R				
Nassa californiana Conrad	X	R	C	R		R		R	
Nassa cerritensis, sp. nov	E		R	C	R				
Nassa fossata Gould	X	M	M	M	C	R	R	R	
Nassa insculpta Carpenter	C		R						
Nassa mendica Gould	X	M	C	R	M	C	M	M	M
Nassa mendica var. *cooperi* Forbes	X	C	C	C	C	C	C	M	M
Nassa perpinguis Hinds	X	M	C	C	M	C	C	R	R
Nassa tegula Reeve	X	R	M	R	R	R	R		
Nassa versicolor var. *hooveri*, var. nov	S		R						
Natica clausa Broderip & Sowerby	N					R		M	R
Natica (*Lunatia*) *lewisii* Gould	X	M	C	M	R				
Neverita recluziana Petit	X	M	C	C	M	R	R	R	
Norrisia norrisii Sowerby	X	R							
Ocinebra barbarensis Gabb	X					R	R		
Ocinebra foveolata Hinds	X		R						
Ocinebra interfossa Carpenter	X	R	M		R	R	R	R	
Ocinebra keepi, sp. nov	E	R	R						
Ocinebra lurida Middendorf	X				R				
Ocinebra lurida var. *aspera* Baird	N	R	C	R	R	R	R		
Ocinebra lurida var. *cancellina* Philippi	S		R						
Ocinebra lurida var. *cerritensis*, var. nov	E			R	R	R	R		
Ocinebra lurida var. *munda* Carpenter	C					R			
Ocinebra micheli Ford	?				R				
Ocinebra perita Hinds	X	M	C		M	M			
Ocinebra poulsoni Nuttall	X	R	M	M	R	R	M		
Odostomia gouldii Carpenter	X					R	R		
Odostomia nuciformis var. *avellana* Carpenter	N					R			
Odostomia tenuis Carpenter	X		R				R		
Olivella biplicata Sowerby	X	C	C	M	C	C	C	R	R

	Living.	Pleistocene.						Pliocene.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island	Timm's Point.
Olivella intorta Carpenter	X	C	C	R	M	C	C	M	
Olivella pedroana Conrad	X	R	R	C	R	M	M	M	
Opalia borealis Gould	X		R						
Opalia crenitoides var. *insculpta* Carpenter	X	R							
Pachypoma inæquale Martyn	X		R		R		R		
Paludestrina curta, sp. nov	E		R				R		
Paludestrina stokesi, sp. nov	E		R				R		
Phasianella compta Gould	X		C			R	R		
Phorcus pulligo Martyn	X				C				
Physa heterostropha Say	X						R		
Pisania fortis Carpenter	E	R	R						
Planorbis tumidus Pfeiffer	S		M				R		
Planorbis vermicularis Gould	N		M				R		
Pleurotoma (Borsonia) bartschi, sp. nov	E					M		M	
Pleurotoma (Dolichotoma) carpenteriana Gabb	X	M	M		R				
Pleurotoma (Dolichotoma) cooperi, sp. nov	E		R						
Pleurotoma (Borsonia) dalli, sp. nov	E					R		R	
Pleurotoma (Borsonia) hooveri, sp. nov	E					R			
Pleurotoma (Leucosyrinx) pedroana, sp. nov	E					R			
Pleurotoma perversa Gabb	X	M	R	R	C	R	R	M	
Pleurotoma (Drillia) renaudi, sp. nov	E					R		R	
Pleurotoma (Spirotropsis) smithi, sp. nov	E					M		M	
Pleurotoma (Dolichotoma) tryoniana Gabb	X		R						
Pomaulax undosus Wood	X		R		R				
Priene oregonensis Redfield	X	R	R		M	R		C	
Puncturella cucullata Gould	N		R			R		M	
Puncturella galeata Gould	N					R		M	
Purpura crispata Chemnitz	N	R	R		C				
Purpura saxicola Valenciennes	X		R						
Pyramidella conica var. *variegata* Carpenter	S		R						
Ranella californica Hinds	X	R	C	R	R				
Rissoa acutelirata Carpenter	S		R						
Scala bellastriata Carpenter	X		R						
Scala crebricostata Carpenter	X	R	M				R		
Scala hemphilli Dall	E		R						

	LIVING.	PLEISTOCENE.						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Scala hindsii Carpenter	X	R	C	R	M	R	M		
Scala indianorum Carpenter	X	R	C	R	M	R	R	R	
Scala tincta Carpenter	X	R	R	R	R	R	R		
Seila assimilata C. B. Adams	X					R			
Serpulorbis squamigerus Carpenter	X	M	M	R	R	R	R		
Sigaretus debilis Gould	X		R	R					
Siphonalia kellettii Forbes	X		R	R	R				
Solariella cidaris A. Adams	X							R	
Solariella peramabilis Carpenter	C							R	
Spiroglyphus lituella Morch	X	C	C	C	C				
Styliferina tenuisculpta Carpenter	?					R			
Taranis strongi sp. nov.	E			R		R	R	R	
Terebra (Acus) simplex Carpenter	X	R	C	M	M	M	M	R	R
Thalotia caffea Gabb	X					R		M	
Tornatina cerealis Gould	X		M			R	M		
Tornatina culcitella Gould	X	R	R	R	R	M	M		
Tornatina eximia Baird	X							R	
Tornatina harpa Dall	X	R	R			R	R		
Triforis adversa Montague	N					R			
Trivia californica Gray	X		R						
Trivia solandri Gray	X					R			
Tritonium gibbosus Broderip	S		R						
Trophon (Boreotrophon) cerritensis, sp. nov.	E			R		R			
Trophon (Boreotrophon) gracilis Perry	X					R		R	
Trophon (Boreotrophon) multicostatus Eschscholtz	N		R			R			
Trophon (Boreotrophon) pedroanus, sp. nov.	E				R	C	C		
Trophon (Boreotrophon) scalariformis Gould	N				R	C		R	
Trophon stuarti Smith	N					R		C	R
Trophon orpheus var. *præcursor*, var. nov.	E					M		C	
Trophon (Boreotrophon) tenuisculpta Carpenter	E							R	
Trophon (Boreotrophon) triangulatus Carpenter	X					R			
Turbonilla adleri (Dall & Bartsch), sp. nov.	E					R			
Turbonilla arnoldi (Dall & Bartsch), sp. nov.	E					R			
Turbonilla aurantia Carpenter	X		R	R		R	R		
Turbonilla crebrifilata Carpenter	X			R		R	R		

	LIVING.	PLEISTOCENE.						PLIOCENE.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
Turbonilla gibbosa CARPENTER	X					R			
Turbonilla laminata CARPENTER	X		R	R		R	R		
Turbonilla latifundia (DALL & BARTSCH), sp. nov.	E	R		R		R	R		
Turbonilla lowei (DALL & BARTSCH), sp. nov.	E		R	R		R	R		
Turbonilla muricata GOULD	S		C	C		R	R		
Turbonilla pentalopha (DALL & BARTSCH), sp. nov.	X					R			
Turbonilla similimis C. B. ADAMS	X		C	C		R	R		
Turbonilla stearnsii (DALL & BARTSCH), sp. nov.	S		R	R			R		
Turbonilla subcuspidata CARPENTER	S		R	R		R	R		
Turbonilla tenuicula GOULD	X		R	R		R	R		
Turbonilla torquata GOULD	X					R			
Turbonilla torquata var. *stylina* CARPENTER	X					R	R		
Turbonilla tridentata CARPENTER	X			R		R	R		
Turritella cooperi CARPENTER	X	M	C	M	M	C	C	C	C
Turritella jewetti CARPENTER	E	R	R		R	M		C	
Vermicularia, sp. indet.	?					R			
Vitrinella williamsoni DALL	X		R			R			
Volvarina varia SOWERBY	X	R	M	C	R	R	R		
Volvula cylindrica CARPENTER	X					R			
ANTHOZOA.									
Caryophyllia arnoldi VAUGHAN	?		R						
Caryophyllia californica (VAUGHAN), sp. nov.	?							R	
Caryophyllia pedroensis (VAUGHAN), sp. nov.	?		R						
Paracyathus pedroensis (VAUGHAN), sp. nov.	?		R						
ECHINOIDEA.									
Echinarachnius excentricus ESCHSCHOLTZ	X	R	C	M	M	C	M		
Strongylocentrotus franciscanus AGASSIZ	X					C			
Strongylocentrotus purpuratus STIMPSON	X					C			
BRYOZOA.									
Bryozoan remains	?							C	
BRACHIOPODA.									
Laqueus jeffreysi DALL	X							R	
Terebratalia smithi, sp. nov.	E							R	

	Living.	Pleistocene.						Pliocene.	
		Upper San Pedro.				Lower San Pedro.			
	San Pedro.	Deadman Island.	Lumber Yard.	Los Cerritos.	Crawfish George's.	Deadman Island.	San Pedro Bluffs.	Deadman Island.	Timm's Point.
SCAPHOPODA.									
Cadulus nitentior Carpenter	X					R			
Dentalium indianorum Carpenter	N				R	M	R		
Dentalium hexagonum Sowerby	X	C	C	C	C	C	M		
Dentalium pseudohexagonum Dall	?		M			R			
Dentalium semipolitum Broderip & Sowerby	S	R	R		R				
CRUSTACEA.									
Balanus concavus Bronn	X	R	M	M	R		M		
Cancer breweri Gabb	E					R			
PISCES.									
Urolophus halleri (?) Cooper	X		R						

CHAPTER II.

THE UPPER PLIOCENE AND PLEISTOCENE FORMATION OF OTHER LOCALITIES OF THE PACIFIC COAST.

IN discussing the occurrence of the Pleistocene deposits at other points along the Pacific Coast it will be necessary, in most instances, to quote the observations of others, as the writer has visited only a few of these localities.

The writer examined a raised beach at Blakeley Point, opposite Seattle, Washington, during the summer of 1900. It consists of sandy deposits lying horizontal upon the upturned and eroded edges of the Astoria Miocene strata. This beach and one or two others in the same vicinity are about ten or twelve feet above the level of Puget Sound, showing a total thickness of about ten feet; they are of late Pleistocene age, undoubtedly later than the last ice age of that country. The following species of marine mollusks in a rather poor state of preservation were obtained from the Point Blakeley raised beach:

Macoma inquinata
Purpura crispata
Saxidomus aratus
Tapes staminea

Several deposits of a similar nature have been reported by J. P. Kimball[1] in the same vicinity. Dr. Kimball is of the opinion that there has been a recent elevation of the shores of the Sound of at least twenty-five feet. This uplift has taken place since the glacial drift was deposited in that region. Dall[2] reports a Pleistocene deposit, overlying beds of Pliocene age, from thirty to forty feet above the sea, near Bruceport, Washington.

Mr. H. W. Turner of the United States Geological Survey collected several specimens of sandstone containing the borings and shells of *Pholadidea penita* Conrad, from an elevation of fifty feet above tide water, at Fort Ross, Sonoma County, California. *Pholadidea penita* not occurring previously to the Pleistocene, this evidence shows that there has been a post-Pleistocene uplift of at least fifty feet at Fort Ross.

On the flanks of several of the little valleys draining into the Bay of San Francisco are deposits known to be of post-Pliocene age. Whitney describes some of these deposits, and makes correlations which are important, if correct. He says:[3]

"A post-Tertiary deposit made up of beds of gravel, sand, clay, and oyster shells rests horizontally upon the upturned edges of the Cretaceous at several localities around Benicia. These are similar to the beds noticed as occurring on the shore between Martinez and Bull's Head Point, which contain fragments of bones of large animals and rolled Tertiary shells. Similar beds, with oysters, were observed on San Pablo Bay between Point Pinole and the Embarcadero; at this locality the beds containing oysters, which rest horizontally on upturned strata of the Tertiary, are elevated twenty feet above the level of the waters of the bay. At Benicia, also, there has been an elevation of several feet since the oyster beds were deposited. With the shells of oysters, those of other species, all now living in the waters of the bay, are found. These deposits evidently belong to the post-Pliocene, and they are of the same age as the beds of gravel, with boulders of gray sandstone, containing the bones of the mastodon and horse, which occur at Bottle Hill near Benicia."

---

[1] Physiographic Geology of the Puget Sound Basin. By J. P. Kimball. Am. Geol., Vol. XIX, 1897, p. 231.

[2] Correlation Papers. Neocene. By W. H. Dall and G. D. Harris. Bull. U. S. Geol. Sur. No. 84, p. 228, 1892.

[3] Geological Survey of California. By J. D. Whitney, State Geologist. Geology, Vol. I, p. 102, 1865.

The Pleistocene deposits on the shore of San Pablo Bay between the Union Oil Refinery and Point Pinole have been visited by Dr. Merriam and the writer. The deposits, which rest on the upturned edges of the San Pablo strata, consist of horizontally bedded layers of sand, gravel, and clay. Teeth of the mammoth, and bones of the giant sloth and extinct bison have been found in these Pleistocene layers by Dr. Merriam. In certain places the Pleistocene layers consist almost entirely of oyster and mussel shells.

List of Fossils from the Pleistocene Deposits on San Pablo Bay between the Union Oil Refinery and Point Pinole.

Ostrea lurida
Ostrea conchaphila
Mytilus edulis
Tagelus californianus

The character of these Pleistocene strata and of their fauna leads the writer to correlate them with the upper San Pedro series.

Deposits of soft yellow sand resting on the Merced (Pliocene) strata in the vicinity of Lake Merced on the San Francisco peninsula have been assigned to the Pleistocene by Lawson[1] and Ashley.[2] The line of demarkation between the Pliocene and Pleistocene at some places mentioned by these authors seems to be in doubt. Both are agreed that there is an unconformity between the two series, and Ashley thinks that there was a period of subaërial erosion between them.

The Pleistocene deposits mentioned by Ashley[3] as occurring along the tops of the sea-cliffs from Montara Point south are partly of fresh-water and partly of marine origin. Those at Purissima are certainly of marine origin, for pholas borings have been found in the old beach-line on which they were deposited. The deposits along the upper edge of this same terrace in the vicinity of Halfmoon Bay are of fresh-water origin, and are very recent. The *Haliotis* mentioned by Ashley as occurring in these deposits are from Indian kitchen-middens, common at many places along the California coast. Similar kitchen-middens near San Mateo have been reported as Quaternary by the same writer.

---

[1] The Geology of the San Francisco Peninsula. By A. C. Lawson. 15th Ann. Rep. U. S. Geol. Surv., 1895, p. 463, *et seq.*

[2] The Neocene Stratigraphy of the Santa Cruz Mountains of California. By G. H. Ashley. Proc. Cal. Acad. Sci., 2nd ser., Vol. V, 1895, p. 347, *et seq.*

[3] *Op. cit.*, p. 349.

In the region surrounding Carmelo Bay[1] are numerous terraces strewn with boulders and pebbles, more or less cemented together, and in several cases with the adjoining rock surfaces showing borings which resemble those of *Pholadidea penita.* No fossils have been found in these deposits, but Lawson believes them to be of Pleistocene origin. He also believes that there was an interruption in the Pleistocene sedimentation, during which time orogenic movements took place. His conclusions are based on the finding of an unconformity between two of the terrace formations in a section north of Abalone Point.

Fairbanks[2] tells of a large area of Pleistocene sediments lying west of Corralitos Creek and north of the summit of the ridge. The beds are horizontal and consist of indistinctly stratified and slightly consolidated sand. This sand formation reaches a maximum thickness of about three hundred feet. Fragments of shells are found over the surface of the deposits up to an elevation of nine hundred feet. The only shells positively identified from the surface of the beds are:

Chlorostoma brunneum *Haliotis (?)* *Lunatia lewisii* *Mytilus californicus* *Purpura canaliculata*

This fauna is similar to that of the Indian kitchen-middens found at so many places along the coast, and it seems probable that the shells are from deposits of this kind. Their occurrence on the surface would add weight to this theory. Another Pleistocene area in this Point Sal district is at the head of the valley north of the dairy, and consists of fragments of bituminous shale, and a deposit of calcium carbonate containing casts of *Crepidula rugosa* and a species of *Purpura.* Fairbanks says these beds are similar to those of Point Loma, near San Diego, " even to the presence on the surface of small concretionary nodules of sand cemented by iron oxide."[3]

From Mallagh Landing, two miles southeast of Port Harford, to Pismo, and from Surf to Santa Barbara the sea-cliffs are capped by deposits of sand and gravel which are probably of Pleistocene age. No fossils were found in any of the localities visited; but in several places, noticeably northwest of Pismo, pholas-bored pebbles were found at the contact between the Pleistocene sands and the underlying eroded Miocene shale, thus showing the marine origin of the Pleistocene deposits.

SANTA BARBARA AND VICINITY.

The Packard's Hill deposits are the most important of the fossiliferous beds in the immediate vicinity of Santa Barbara. Packard's Hill is a ridge about three hundred feet in height, which begins a short distance northwest of the western end of the beach boulevard, and extends for nearly a mile due north. Its eastern slope is almost precipitous, and outcrops of the fossil-bearing strata are found over the whole slope. The best outcrops, and the one from which all the fossils were obtained by the writer, are about two-thirds of the way up the hill. The hill consists of layers of fine, soft, light yellow sand and marl, which is hardened in places by the lime leached from shells. The dip of the beds is nearly due south at an angle of 15°. The hardened strata are darker colored than the softer beds, and as a rule are more fossiliferous. The fossils in the soft strata are very fragile, but by using care some fine specimens may be obtained from them.

---

[1] The Geology of Carmelo Bay By A. C. Lawson. Bull Dept. Geol., Univ. Cal., Vol. I., p. 52, *et seq.*

[2] The Geology of Point Sal By H W. Fairbanks Bull. Dept. Geol., Univ. Cal., Vol. II., 1896, p. 6-8.

[3] *Op. cit.*, p. 8.

The fauna of the Packard's Hill deposits is similar to that of the upper horizon of the San Diego formation, and is probably equivalent to that part of the Pliocene which is missing between the Deadman Island Pliocene and the overlying lower San Pedro series (Pleistocene). The close relation between the *Pecten bellus* Conrad found in the Packard's Hill Pliocene and the *Pecten hemphilli* Dall of the upper horizon in the San Diego formation is an indication of a more or less close relation between the two formations. *Pecten bellus*, *Terebratalia hemphilli*, *Laqueus jeffreysi*, and *Venus perlaminosa* are the most characteristic specimens found at Packard's Hill.

A bluff nearly thirty feet in height begins just west of the western end of the beach boulevard at Santa Barbara, and extends southwest along the ocean. For the first eighth of a mile, or along the edge of the first cove, the bluff consists of rather evenly bedded, soft, brownish yellow, sandy marl, which dips S. 30° E. 14°. Around the point one-eighth mile southwest of the bath-house the bluff consists of irregularly bedded gravels and sand, which seem at some places to rest unconformably upon the fossiliferous marl beds, although false bedding is so prevalent in the deposits along this bluff that any positive evidence as to the conformability of the strata was hard to obtain. Further southwest along the coast, the gravels and sand rest upon the upturned and eroded edges of the contorted Miocene shales. At one place about half a mile south of the bath-house, where these Pleistocene sands and gravels rest upon the Miocene shales, the Pleistocene deposits were impregnated with asphaltum. In this same place a fragment of the fossiliferous sandstone, similar to that which is found at the northern end of the bluff near the bath-house, was found in the Pleistocene gravels; thus giving evidence that there are two distinct horizons in the Pleistocene along this bluff.

Alternating strata of sand and gravel, showing false bedding, are exposed in the sea-cliff east of the Santa Barbara wharf. A stratum of shell fragments was found near the western end of this cliff, but no specific determination of the fossils could be made on account of their poor state of preservation. The strata of this bluff are similar to, and probably contemporaneous with, the late Pleistocene strata in the bluff southwest of the bath-house.

LIST OF FOSSILS COLLECTED FROM THE PLIOCENE AND PLEISTOCENE FORMATIONS OF SANTA BARBARA, CALIFORNIA.

	Bath-house Pleistocene	Packard's Hill Pliocene
Acmæa insessa HINDS	X	
Adeete gracilior CARPENTER	X	
Amphissa corrugata REEVE	X	
Balanus concavus BRONN		X
Bela fidicula GOULD	X	
Bittium asperum GABB	X	
Bittium quadrifilatum CARPENTER	X	
Bryozoa sp. (?)	X	
Cardium corbis MARTYN	X	
Calliostoma gemmulatum CARPENTER		X
Chrysodomus tabulatus BAIRD	X	
Clathurella conradiana GABB	X	X
Columbella (Astyris) gausapata GOULD	X	
Columbella (Astyris) gausapata var. *carinata* HINDS	X	
Columbella (Astyris) tuberosa CARPENTER	X	
Crepidula adunca SOWERBY	X	
Crepidula navicelloides NUTTALL	X	
Cythara branneri, sp. nov	X	
Diastoma, sp. (?)	X	
Fusus robustus TRASK	X	
Galerus mammillaris BRODERIP	X	X
Glottidia albida HINDS		X
Lacuna compacta CARPENTER	X	
Laqueus jeffreysi (?) DALL		X
Leptothyra bacula CARPENTER	X	
Leptothyra paucicostata DALL	X	
Lucina acutilineata CONRAD	X	
Lucina californica CONRAD	X	
Macoma sp. (?	X	
Mangilia angulata CARPENTER	X	
Mangilia interfossa var. *pedroana*, var. nov.	X	
Margarita pupilla GOULD	X	
Mitromorpha intermedia, sp. nov.	X	
Modiola fornicata CARPENTER	X	
Nassa mendica GOULD	X	
Natica clausa BRODERIP & SOWERBY	X	X
Ocinebra barbarensis GABB	X	
Ocinebra lurida var. *aspera* BAIRD	X	
Ocinebra perita HINDS	X	
Odostomia nuciformis var. *avellana* CARPENTER	X	
Odostomia gouldii CARPENTER	X	
Olivella biplicata SOWERBY	X	
Panopea generosa GOULD		X
Pecten bellus CONRAD		X
Pecten caurinus GOULD	X	X
Pecten hastatus SOWERBY	X	X
Pecten jordani, sp. nov.		X
Pecten opuntia DALL		X
Pododesmus macroschisma DESHAYES	X	
Protocardia centifilosa CARPENTER	X	X
Psephis salmonea CARPENTER	X	X
Puncturella cuculata GOULD		X
Strongylocentrotus purpuratus STIMSON	X	
Terebratalia hemphilli DALL		X
Tornatina culcitella GOULD	X	
Trophon gracilis PERRY	X	
Trophon orpheus var. *præcursor*, var. nov.	X	
Turbonilla tridenta CARPENTER	X	
Venericardia barbarensis STEARNS	X	X
Venericardia ventricosa GOULD	X	X
Venus perlaminosa CONRAD	X	X

Recognizable fossils are found only in the few beds of soft, brownish-yellow marl at the northeastern end of the bluff west of the bath-house. The lowest strata exposed near the bath-house consist almost wholly of bryozoan remains, among which are scattered a few shells. The bryozoan remains give place to sand in the beds a few feet above. The large shells in the strata are poorly preserved, but the smaller fossils, especially the gastropods, are abundant and well preserved.

The fauna of the beds west of the bath-house is similar to that of the lower San Pedro series (lower Pleistocene) of Deadman Island, and these Santa Barbara beds are probably contemporaneous with the lower San Pedro deposit of Deadman Island. Several nearly perfect tests of *Strongylocentrotus purpuratus* were found in the bath-house strata, the first tests of this species that have been recorded from the Pleistocene. *Echinarachnius excentricus* was also found in the same bed. The stratigraphic relation between the Packard's Hill and bath-house beach fossiliferous deposits was not obtained, but the former are probably the older strata, although both may belong to the same series and be nearly contemporaneous.

Lithologically the two beds are somewhat similar, but faunally they differ considerably. The absence of *Pecten bellus*, *Terebratalia hemphilli*, *Laqueus jeffreysi* and *Pecten opuntia* from the bath-house beach strata; and the absence of the two species of echinoderms and many species of gastropods from the Packard's Hill beds, are the noticeable differences between the two faunas.

Whitney mentions the following localities, besides those already cited, where Pleistocene deposits were found by the State Survey: At Hill's Ranch,[1] about six miles west of Santa Barbara, "the bituminous slate is covered unconformably, as at Santa Barbara, by a heavy deposit of post-Pliocene age, which here attains a thickness of from eighty to one hundred feet. The bituminous slates, which are highly contorted and turned upon edge, lie nearly on a level with the ocean; and on their edges rests a body of soft, arenaceous, and loose gravelly materials, sometimes very slightly consolidated, and in which are long fissures filled with asphaltum." On the southwestern face[2] of Santa Barbara Island is a raised beach thirty feet above tide level, containing marine shells, which Whitney thinks is the same formation as that found at Santa Barbara. Near the Santa Maria River the hills of Miocene shale are capped with horizontal post-Pliocene deposits.[3]

Dr. Stephen Bowers[4] describes the Pleistocene of Santa Rosa Island from notes taken by Dr. L. G. Yates: "On the north side of the island, about ten miles from the wharf, and near the mouth of Soledad Canyon, there is a fine exposure of strata consisting of about ninety feet of post-Pliocene deposits, containing fossil bones of vertebrates and at one place fossil Physas, at a depth of some seventy-five feet below the surface. This deposit is horizontal and overlies strata of older rocks, probably Pliocene, which dip 13° northeast, and contain Pectens and Turbinelias in abundance."

Judging by the fauna of the Pleistocene deposits on Santa Rosa Island, they are probably of fresh-water origin. An elephant's tooth and other elephant remains are reported by Dall[5] as having been found by W. G. Blunt and Voy on Santa Rosa Island.

Ventura.—The most striking thing in relation to the geology of the vicinity of

---

[1] Geological Survey of California. By J. D. Whitney, State Geologist. Geology, 1865, Vol. I, p. 132.

[2] *Op. cit.*, p. 183.

[3] *Op. cit.*, p. 137.

[4] Santa Rosa Island. By Rev. Stephen Bowers. Smithsonian Report, 1877, p. 317.

[5] Correlation Papers. Neocene. By W. H. Dall and G. D. Harris. Bull U. S. Geol Sur., No. 84, 1892, p. 217.

Ventura is the great development and the high elevation above sea-level of the Pleistocene deposits in that locality. The terrace on which the city is located and the hills immediately back of the city are of Pleistocene origin. This is shown by the marine fauna collected at different localities in the vicinity.

The first locality visited was along the course of the old irrigating ditch, which runs at an elevation of about two hundred and fifty feet above sea-level on the eastern side of the valley west of Ventura. The hills along which this ditch runs rise to over five hundred feet in height, and are composed of fine, soft, yellow sandstones which dip south at an angle of 50°. These sandstones were examined for about one-half mile north of Ventura along the ditch. This exposure represents a thickness of at least one thousand feet. Several of the strata were fossiliferous and yielded a fauna similar to that of the Pleistocene of San Pedro. The upper beds, or those nearest the ocean, contained a fauna similar to the upper San Pedro series, while that of the beds further down in the series contained such species as are commonest in the lower San Pedro series. The lower beds were characterized by the great abundance of *Turritella cooperi*. An outcrop in a ravine near the new hospital on the north side of Ventura contained a fauna similar to that of the upper beds along the ditch.

There is an exposure of fossiliferous Pleistocene strata between Barlow's ranch house, three miles east of Ventura, and a prominent point, called "The Peak," north of the house. "The Peak" has an elevation of one thousand and seventy feet, according to the United States Coast and Geodetic Survey. The highest point at which fossils were obtained was about two hundred and fifty feet below the summit, but the same formation extends to the top, and probably comprises all of the sediments forming the elevated ridge which lies back of Ventura from the ocean, and extends parallel with the coast for several miles east of Ventura.

The fossiliferous strata exposed were about twenty-five feet thick, and consisted of five or six layers of shells from three to nine inches in thickness, separated by fine, soft, light yellow sand layers. The whole series was unconsolidated, except for local hardenings in the shell layers, and was oxidized but little. The dip of the strata was from 30° to 40° south, which corresponded nearly to the general slope of the main ridge, whose axis was parallel with the coast, and of which "The Peak" was the highest point.

The fauna collected consisted of about fifty species, all of which are common to the San Pedro series. The similarity between this fauna and that of the upper San Pedro series, and the incoherency and lack of oxidation of the matrix, leave little doubt as to the age of these beds. They are of Pleistocene origin, and, moreover, are synchronous with the upper San Pedro series. Their elevation of about eight hundred feet above the sea-level seems remarkable, but only confirms the theory of the recent great elevation of the coast of California from San Francisco southward.

LIST OF FOSSILS COLLECTED FROM THE PLEISTOCENE FORMATIONS IN THE VICINITY OF VENTURA, CALIFORNIA.

	Barlow's ranch.	Irrigating ditch.		Barlow's ranch.	Irrigating ditch.
Acmæa pelta Eschscholtz	X		*Modiola fornicata* Carpenter	X	
Actæon (Rictaxis) punctocælata Carpenter	X		*Monoceros engonatum* Conrad	X	
Angulus buttoni Dall	X		*Nassa californiana* Conrad	X	
Anomia lampe Gray	X		*Nassa fossata* Gould	X	X
Balanus concavus Bronn	X		*Nassa mendica* Gould	X	X
Bela fidicula Gould		X	*Nassa perpinguis* Hinds	X	X
Bittium asperum Gabb	X		*Neverita recluziana* Petit	X	X
Cadulus nitentior Carpenter	X		*Neverita recluziana* var. *alta* Dall	X	X
Cancellaria tritonidea Gabb	X	X	*Ocinebra lurida* var. *aspera* Baird		X
Chione succincta Valenciennes	X		*Odostomia gouldii* Carpenter	X	
Chlorostoma funebrale A. Adams	X		*Odostomia nuciformis* var. *avellana* Carpenter	X	X
Chorus belcheri Hinds	X		*Odostomia tenuis* Carpenter	X	X
Chrysodomus tabulatus Baird		X	*Olivella biplicata* Sowerby	X	X
Columbella (Astyris) gausapata Gould	X	X	*Olivella intorta* Carpenter	X	X
Columbella (Astyris) gausapata var. *carinata* Hinds	X	X	*Olivella pedroana* Conrad	X	
Crepidula adunca Sowerby	X		*Pecten latiauritus* var. *monotimeris* Conrad	X	
Cryptomya californica Conrad	X	X	*Pecten ventricosus* Sowerby		X
Cylichna alba Brown	X		*Pleurotoma carpenteriana* Gabb		X
Dentalium hexagonum Sowerby	X		*Purpura saxicola* Valenciennes		X
Donax lævigata Deshayes	X		*Rissoa acutelirata* Carpenter		X
Drillia hemphilli Stearns	X		*Saxidomus aratus* Gould	X	
Drillia inermis Hinds	X	X	*Scala crebricostata* Carpenter	X	X
Drillia inermis var. *penicillata* Carpenter	X	X	*Scala tincta* Carpenter	X	
Echinarachnius excentricus Eschscholtz	X		*Tapes tenerrima* Carpenter	X	
Eulima micans Carpenter	X		*Terebra simplex* Carpenter	X	
Eulima hastata Sowerby	X		*Tornatina culcitella* Gould	X	
Lacuna compacta Carpenter	X		*Tornatina harpa* Dall	X	
Littorina scutulata Gould	X		*Turritella cooperi* Carpenter	X	X
Macoma nasuta Conrad	X	X	*Turbonilla laminata* Carpenter	X	
Mactra catilliformis Conrad	X		*Turbonilla*, four sp. (?)	X	
Mangilia angulata Carpenter	X		*Yoldia cooperi* Gabb	X	
Mangilia sp. (?)		X			

Watts and Cooper give lists of fossils from several localities in Santa Barbara, Ventura and Los Angeles counties[1] which suggest the Pleistocene age of the deposits from which the fossils were taken. The faunas are generally so small, and the stratigraphic notes so incomplete, that it is not possible to make any definite correlations between these deposits and the different horizons of the San Pedro series.

---

[1] The Gas and Petroleum Yielding Formations of the Central Valley of California. By W. L. Watts. Bull. Cal. State Mining Bureau, No. 3, 1894.

Lists of Fossils Identified by Dr. J. G. Cooper. Oil and Gas Yielding Formations of Los Angeles, Ventura, and Santa Barbara counties. By W. L. Watts. Bull Cal. State Mining Bureau, No. 11, 1897, pp. 79-87.

Port Los Angeles.—The writer has obtained the following species from a hard, sandy stratum underlying more than a hundred feet of soft, sandy deposits in the mouth of the canyon at the end of the large wharf at Port Los Angeles, near Santa Monica:

Astyris gausapata
Bela sancta-monica
Bittium asperum
Nassa mendica var. *cooperi*
Nassa perpinguis
Neverita recluziana
Olivella biplicata
Olivella intorta
Ostrea lurida (?)
Pisania fortis
Pleurotoma carpenteriana
Pleurotoma perversa
Tapes staminea
Turritella cooperi
Trophon scalariformis
Venericardia ventricosa

The stratum from which the above fossils were obtained is probably Pleistocene, corresponding to the lower San Pedro series of Deadman Island, for lithologically and faunally the strata are quite similar. The overlying beds are soft and unfossiliferous, and lie slightly unconformably on the lower fossiliferous stratum; and although they contain no fossils, still, from lithological and stratigraphical reasons, it is probable that they are equivalent to the upper San Pedro deposits. These Pleistocene strata extend down the coast from the great wharf to about one-half mile below Santa Monica.

San Clemente Island.—The post-Pliocene deposits of San Clemente Island are small. W. S. T. Smith[1] says that they consist of fine sand and rolled pebbles, and have a maximum thickness of only ten feet. *Lucina californica* is the only fossil shell reported from these deposits.

Newport.—Much of the coast line from Long Beach to San Diego consists of more or less elevated deposits of Pleistocene age. Deposits of Pleistocene age have been examined by W. L. Watts in the vicinity of Newport, Orange county.[2] About a mile north of the town of Newport is a formation of soft sandstone and yellowish clay-shale, with layers of hard calcareous strata, and some strata which appear to be made up largely of diatomaceous material. These deposits contain the following species, which have been identified by Dr. J. C. Merriam:

Anomia lampe
Cardium panamense [= *C. procerum*]
Chione simillima
Chione succincta
Crucibulum spinosum
Macoma inquinata
Neverita recluziana
Pecten aequisulcatus [?=*P. ventricosus*]
Placunanomia macroschisma
Pomaulax undosus
Tapes staminea
Zirphaea crispata [= *Z. Gabbi*]

The fauna given above shows that this deposit is equivalent to the upper San Pedro series.

The oil-sand and sandstone west of the inner bay at Newport contain the following species:[3]

Bittium asperum
Bryozoan remains
Crepidula adunca
Lucina californica
Macoma inquinata
Monoceros engonatum
Nassa fossata
Nassa perpinguis
Olivella biplicata
Petricola carditoides
Tapes staminea

This fauna corresponds to that of the upper San Pedro series, although no definite relation can be established, owing to the lack of characteristic fossils.

---

[1] A Geological Sketch of San Clemente Island. By W. S. T. Smith. 18th Ann. Rept. U. S. Geol. Sur., Part II., 1898, p. 492.

[2] Oil and Gas Yielding Formations of California. By W. L. Watts. Bull. Cal. State Mining Bureau, No. 19, 1900, pp. 61 and 223.

[3] *Op. cit.* p. 233.

San Juan Capistrano.—The following fossils were taken from a shallow well at San Juan Capistrano, in which were also found a tusk and some of the bones of a mastodon:[1]

Arca (cf.) *sulicosta*
Crepidula excavata
Nassa mendica
Natica clausa
Ostrea (?)
Leda (?)
Turritella cooperi
Venericardia borealis [= *V. ventricosa*]
Vola (?)

Dr. Merriam is of the opinion that these fossils are of Pliocene age—an opinion borne out by the similarity of this fauna to that of the Deadman Island Pliocene.

At Bell Station, on the Los Angeles Terminal Railway in Los Angeles County, the following fossils were obtained from a well at a depth of between 920 and 1,320 feet.[2]

Amiantis callosa
Echinarachnius excentricus
Macoma nasuta
Myurella (aff.) *simplex* [= *Terebra* id.]
Lunatia lewisii
Olivella bœtica [= *O. pedroana*]
Raeta undulata
Tornatella (?)

This is an upper San Pedro fauna, and its occurrence at such a great depth has much significance in showing the great amount of sedimentation that has taken place in the region between Los Angeles and the ocean since the deposition of the San Pedro series.

SAN DIEGO AND VICINITY.[3]

The Pliocene and Pleistocene deposits of San Diego are similar to those of San Pedro, and the geologic history of the two regions has been nearly the same. During the Pliocene epoch the region now occupied by San Diego Bay and vicinity was a great basin in which coarse gravels and fine sands were deposited. The earlier sediments, which are now exposed along the northern portion of the San Diego mesa, consist of thick deposits of incoherent coarse gravels, while the later deposits are made up of plainly bedded yellow sandstones. After the deposition of these layers, there was an interruption of sedimentation, which was followed during Pleistocene times by an inundation and deposition of fossiliferous gravels and sands over much of the San Diego region.

Pacific Beach—Pliocene.—The best exposure of the Pliocene is found at Pacific Beach, on the coast ten miles north of San Diego. A perpendicular bluff, varying in height from four feet at Ocean Front to over sixty feet one mile north, forms the coast line of Pacific Beach. This bluff is composed of brownish yellow sandstones of Pliocene age, which dip gently toward the south, and disappear successively beneath the beach as one approaches Ocean Front from the north. The total thickness of the strata exposed is about two hundred feet. The upper one hundred feet are fossiliferous, while the lower layers are devoid of fossils. The unfossiliferous sandstone rests upon coarse incoherent gravels of unknown thickness.

There appear to be two quite distinct horizons in the fossiliferous section of the Pacific Beach Pliocene. Stratigraphically no distinction can be made, as the whole series of strata rest conformably upon one another, but faunally there is much difference between the two horizons. The lower fossiliferous strata are distinguished by *Pecten expansus*, *Pecten stearnsii*, *Opalia anomala*, and *Opalia varicostata*, *Pecten expansus* being very numerous. The upper beds have few *Pecten expansus*, but are characterized by *Pecten hemphilli*, which completely replaces the *Pecten stearnsii* of the lower layers. *Echinarachnius excentricus* and *Crepidula grandis* are also common in the upper layers.

---

[1] *Op. cit.*, pp. 59 and 222.

[2] *Op. cit.*, p. 223.

[3] The late Tertiary and Pleistocene formations in the vicinity of San Diego are mentioned in the following papers:
Distribution of California Tertiary Fossils. By W. H. Dall. Proc. U. S. Nat. Museum, Vol I, 1879, pp. 26–30.
North American Tertiary Horizons. By W. H. Dall. 18th Ann. Rept. U S. Geol. Sur., Part II, 1898, p. 335.
Geology of San Diego County; also of portions of Orange and San Bernardino Counties. By H. W. Fairbanks. 11th Ann. Rept. Cal State Mineralogist, 1893, pp. 76–120.

The series of Pliocene strata exposed at Pacific Beach has been named the San Diego formation by Dall,[1] who places it below the Merced formation. At another place in this paper the writer brings forward reasons for placing the San Diego formation above the Merced. Besides the reasons given at that place (page 17) there is other evidence showing that the San Diego formation is part of the latest Pliocene. This is the occurrence in it of *Echinarachnius excentricus*. This species of echinoderm is not found in the Merced series or in any of the underlying formations, so far as known, but is found in the lower San Pedro series (lowest Pleistocene) and in all of the succeeding formations, and is still living. Considering the short geologic range usually covered by species of echinoderms, this evidence strongly favors the theory that the San Diego formation is at the top of the Pliocene, and probably takes in a part of the lower San Pedro series.

The lithologic and stratigraphic similarity of the San Diego formation to the Deadman Island Pliocene is marked. Both consist of rather fine, brownish yellow sand strata only moderately consolidated, except locally, with low dip, and showing the effect of only a slight movement since their deposition. Both formations are overlain unconformably by strata of Pleistocene origin. The faunal aspects of the two formations are somewhat different. *Pecten expansus* of the San Diego formation replaces *Pecten caurinus*, which is abundant in the Pliocene of Deadman Island, and numerous species are found in the Deadman Island Pliocene which do not occur in the Pacific Beach Pliocene deposits. *Pecten stearnsii* is common to both formations, and as its geologic range is very limited, it is strong evidence of the contemporaneity of the two formations. Correlating more accurately, the Deadman Island Pliocene is probably contemporaneous with the lower (Pliocene) horizon at Pacific Beach, for *Pecten stearnsii* is limited to that horizon in the San Diego formation, so far as is known.

Pacific Beach—Pleistocene.—The upper six to ten feet of the Pacific Beach bluff is composed of a gravel and sand formation which rests unconformably upon the Pliocene strata. The line of demarkation between the Pliocene and the upper Pleistocene formation is generally distinct, as the lower layer of the Pleistocene is of coarse, fossiliferous gravel, while the underlying Pliocene strata are of fine sand. Well preserved fossils are found at many points in this Pleistocene layer along Pacific Beach, while at other places in the same stratum the fossils are so brittle that it is impossible to remove them from the soft matrix. The fauna of this Pleistocene stratum is very similar to that of the upper San Pedro deposits exposed at the north point of the San Pedro bluff. The break between the faunas of the Pacific Beach Pliocene and the overlying Pleistocene is much greater than that between the Deadman Island Pliocene and its overlying Pleistocene (lower San Pedro series) layer.

---

[1] North American Tertiary Horizons. By W. H. Dall. 18th Ann. Rept. U. S. Geol. Survey, Part II, 1898, p. 335.

San Diego Mesa—Pliocene.—The San Diego mesa is composed of Pliocene strata. Outcrops of the soft yellow and brown Pliocene sandstone occur in many places in the northern part of the city. A good exposure is found at the north end of Tenth street, a short distance northwest of the Russ school, where a cut on both sides of a small ravine reveals a section of the Pliocene about fifty feet thick. This exposure is only about two hundred feet north of the "San Diego well," which was dug about twenty years ago, and which has become famous through the discussion of the age of the fossils which were taken from it. Mr. Hemphill, who obtained the fossils from this well during its excavation, informed the writer that fossiliferous strata were penetrated to a depth of one hundred and forty-nine feet. As the exposure of the San Diego formation above the mouth of the well is fifty feet thick, the fossil-bearing strata of the Pliocene formation of the San Diego mesa are at least two hundred feet in thickness. The dip of the strata above the well is south, or toward the bay, at an angle of eight or ten degrees.

Twenty-sixth Street—Pleistocene.—A bluff about eighteen feet high rises from the edge of the bay at the foot of Twenty-sixth street, San Diego, and extends for two or three blocks both toward the east and toward the west from Twenty-sixth street, forming the shore line along this part of the bay. At the base of this bluff, and covered by the water at high tide is a stratum six inches thick made up almost entirely of the upper valves of *Anomia limatula.* No right valves were found in this deposit, and this species seemed to be restricted to this layer. A stratum of fine, yellow fossiliferous sand, four or five feet thick, rests upon the *Anomia* beds; and above the fossiliferous bed is about twelve feet of fine brown sand, overlain by sandy soil. *Dosinia ponderosa*, *Callista newcombiana*, *Mactra californica*, and *Cardium procerum* are the predominating species in the yellow sand stratum. The fauna of this locality is equivalent to that of the upper San Pedro series at San Pedro.

Spanish Bight—Pleistocene.—The Coronado peninsula is a long, low, narrow sand-spit lying between San Diego Bay and the ocean. Near its western end is a small inlet on the bay side, known as Spanish Bight. The western shore-line of this inlet is a bluff varying in height from twelve to eighteen feet, while the stratum at the base of the bluff forms the beach, and is covered by the water at high tide. This lowest layer is composed of a firm, fine brown sand in which are imbedded numerous large *Amiantis callosa*, which have the appearance of living shells, so naturally do they lie on the sand. An attempt to remove them, however, dispels the delusion, for in most cases they are quite firmly imbedded in the sand layer.

There are three feet of fine, soft, unfossiliferous gray sand above the *Amiantis* layer, and this is overlain by a deposit, varying in thickness from three to five feet, of soft gray sand, which is very fossiliferous near its base and gradually grades into the almost unfossiliferous gray sand a few feet above. About twelve feet from the base of the bluff is a layer from three to six inches thick containing numerous *Donax lævigata* cemented together. This Donax layer is the uppermost fossiliferous stratum, the bluff above this being composed of unfossiliferous sands. The fauna of the Spanish Bight deposits is similar to that of the upper San Pedro series at Los Cerritos, and the deposits are probably of contemporaneous origin.

LIST OF FOSSILS COLLECTED FROM THE PLIOCENE AND PLEISTOCENE FORMATIONS OF SAN DIEGO, CALIFORNIA.

	PLEISTOCENE			PLIOCENE	
	Foot of 26th street	Spanish Bight	Pacific Beach	Pacific Beach	Russ School
Acmaea insessa HINDS		X			
Acmaea pelta ESCHSCHOLTZ			X		
Acteon traskii STEARNS		X			
Acteon (Rictaxis) punctocaelata CARPENTER		X			
Amiantis callosa CONRAD		X			
Amphissa versicolor DALL			X		
Anomia lampe GRAY		X	X		
Anomia limatula DALL	X				
Astarte branneri, sp. nov.	X				
Balanus concavus BRONN		X	X		X
Bittium asperum GABB			X		
Bittium williamsoni, sp. nov.		X			
Cadulus nitentior CARPENTER		X			
Callista newcombiana GABB	X				
Calliostoma canaliculatum MARTYN		X			
Calliostoma costatum MARTYN			X		
Calliostoma gemmulatum CARPENTER		X			
Calliostoma tricolor GABB		X			
Cancer, sp. indet.		X			
Cardium procerum SOWERBY	X	X			
Cardium quadrigenarium CONRAD	X		X		
Cerithidea californica HALDEMANN	X		X		
Chione fluctifraga SOWERBY	X				
Chione simillima SOWERBY	X				
Chione succincta VALENCIENNES	X				
Chlorostoma funebrale A. ADAMS					
Chlorostoma gallina FORBES			X		
Chlorostoma montereyi KIENER			X		
Clidiophora punctata CONRAD		X			
Cypudella bimaculata DALL	X				
Columbella (Aesopus) chrysalloidea CARPENTER	X				
Columbella (Astyris) gausapata GOULD	X		X		
Columbella (Astyris) gausapata var. *carinata* HINDS		X			
Columbella (Astyris) tuberosa CARPENTER		X			
Conus californicus HINDS		X	X		

	PLEISTOCENE.			PLIOCENE.	
	Foot of 26th street.	Spanish Bight.	Pacific Beach.	Pacific Beach.	Russ school.
Cooperella subdiaphana Carpenter		X			
Corbula luteola Carpenter	X				
Crepidula adunca Sowerby		X			
Crepidula grandis Middendorf				X	
Crepidula onyx Sowerby		X	X		
Crucibulum spinosum Sowerby	X		X		
Cryptomya californica Conrad	X	X			
Cylichna alba Brown		X			
Delphinoidea coronadoënsis, sp. nov		X			
Dentalium hexagonum Sowerby	X	X	X	X	X
Dentalium pseudohexagonum Dall		X			
Diplodonta orbella Gould	X				
Diplodonta serricata Reeve	X				
Donax lævigata Deshayes	X	X	X		
Dosinia ponderosa Gray	X				
Drillia cancellata Carpenter		X			
Drillia hemphilli Stearns	X	X			
Drillia incisa Carpenter			X		
Drillia inermis Hinds		X	X		
Drillia inermis var. *penicillata* Carpenter		X	X		
Echinarachnius excentricus Eschscholtz	X	X	X	X	X
Eulima hastata Sowerby		X			
Eulima micans Carpenter		X			
Eupleura muriciformis Broderip	X				
Fissurella volcano Reeve			X		
Glycymeris barbarensis Conrad			X		
Haliotis fulgens Philippi		X			
Hipponyx cranioides Carpenter		X			
Hipponyx tumens Carpenter			X		
Kellia laperousii Deshayes		X			
Lævicardium substriatum Conrad	X				
Lacuna compacta Carpenter		X			
Lacuna solidula (Loven) Carpenter			X		
Lamellaria stearnsii Dall	X				
Leda hamata Carpenter		X			
Leda taphria Dall		X	X	X	
Littorina scutulata Gould		X	X		
Lucina acutilineata Conrad			X		

	Pleistocene			Pliocene	
	Foot of 26th street	Spanish Bight.	Pacific Beach	Pacific Beach	Russ School.
Lucina californica Conrad			X		
Lucina nuttalli Conrad	X		X	X	
Lucina tenuisculpta Carpenter		X			
Macoma indentata Carpenter		X			
Macoma inquinata Deshayes	X				
Macoma nasuta Conrad		X	X	X	
Macoma nasuta var. *kelseyi* Dall	X				
Macoma secta Conrad		X			
Macoma yoldiformis Carpenter		X			
Mactra californica Conrad	X				
Mactra (Spisula) catilliformis Conrad	X	X	X	X	
Mactra exoleta Gray		X	X		
Mactra (Spisula) falcata Gould		X			
Mangilia angulata Carpenter		X	X		
Mangilia striosa C. B. Adams		X			
Melampus olivaceus Carpenter	X				
Metis alta Conrad		X		X	
Modiola recta Conrad	X		X	X	
Monoceros engonatum Conrad			X		
Murex (Pteronotus) nuttalli Conrad	X				
Nassa californiana Conrad			X		
Nassa cerritensis, sp. nov		X			
Nassa fossata Gould		X	X		
Nassa mendica Gould		X	X		
Nassa mendica var. *cooperi* Forbes			X		
Nassa perpinguis Hinds		X	X		
Nassa tegula Reeve	X	X			
Neverita recluziana Petit		X	X	X	
Norrisia norrisii Sowerby			X		
Nucula suprastriata Carpenter		X			
Ocinebra interfossa Carpenter			X		
Ocinebra lurida Middendorf			X		
Ocinebra poulsoni Nuttall	X				
Ocinebra perita Hinds			X		
Odostomia nuciformis var. *avellana* Carpenter		X			
Odostomia tenuis Carpenter		X			
Olivella biplicata Sowerby		X	X		
Olivella intorta Carpenter	X		X		

	Pleistocene.			Pliocene.	
	Foot of 26th street.	Spanish Bight.	Pacific Beach.	Pacific Beach.	Russ School
Olivella pedroana Conrad		X	X		
Opalia anomala Stearns				X	
Opalia varicostata Stearns				X	
Ostrea lurida Carpenter	X		X		
Ostrea veatchi (?) Gabb				X	X
Pecten expansus Dall				X	
Pecten hastatus Sowerby				X	
Pecten hemphilli Dall				X	X
Pecten hericeus Gould				X	
Pecten latiauritus Conrad	X	X			
Pecten latiauritus var. *monotimeris* Conrad		X			
Pecten opuntia Dall				X	
Pecten stearnsii Dall				X	
Pecten subventricosus Dall				X	
Pecten ventricosus Sowerby	X				
Periploma argentaria Conrad	X	X			
Petricola carditoides Conrad		X			
Phasianella compta Gould	X				
Pisania fortis Carpenter			X		
Pleurotoma carpenteriana Gabb			X		
Pododesmus macroschisma Deshayes				X	
Pomaulax undosus Wood			X		
Pteronotus festivus Hinds		X			
Purpura crispata Chemnitz				X	X
Ranella californica Hinds			X		
Saxidomus aratus Gould	X				
Scala crebricostata Carpenter	X				
Scala tincta Carpenter	X		X	X	X
Semele decisa Conrad	X				
Semele pulchra Sowerby	X				
Serpulorbis squamigerus Carpenter			X		
Siliqua lucida Conrad	X	X			
Siliqua patula var. *nuttalli* Conrad		X			
Siphonalia kellettii Forbes			X		
Solen rosaceus Carpenter		X			
Strongylocentrotus purpuratus		X		X	
Tagelus californianus Conrad	X				
Tapes staminea Conrad	X	X		X	X

	PLEISTOCENE			PLIOCENE	
	Foot of 8th street	Spanish Bight	Pacific Beach	Pacific Beach	Russ School.
Tapes tenerrima Carpenter		X			
Tellina bodegensis Hinds		X			
Terebra simplex Carpenter	X	X	X		
Tivela crassatelloides Conrad	X	X			
Tornatina cerealis Gould		X			
Tornatina culcitella Gould	X	X			
Tornatina harpa Dall		X			
Tresus nuttalli Conrad		X			
Turritella cooperi Carpenter			X	X	X
Turbonilla (four species)		X			
Vitrinella, sp. indet		X			
Venericardia ventricosa (?) Gould			X		
Volvarina varia Sowerby	X				
Volvula cylindrica Carpenter	X				
Yoldia cooperi Gabb		X			

CHAPTER III.

FAUNAL RELATIONS.

1. PLIOCENE.

The fauna of the Deadman Island Pliocene strata is somewhat similar to the fauna which is now living in the waters only a short distance offshore from San Pedro. Dredging[1] has shown this, and has also shown that the sediments now being deposited off San Pedro are similar to those which make the strata of the Deadman Island and Timm's Point Pliocene. The Pliocene strata consist for the most part of rather fine clayey brown sand which has its counterpart in the fine sand and mud now being deposited off shore from San Pedro. The Pliocene fauna, although quite similar to the fauna now living off San Pedro, still has many species which are found living only north of that place. To state it more precisely, 18.5 per cent. of the species found in the Deadman Island Pliocene fauna are found living now only to the north of San Pedro. Many of these northern species are limited in range to the boreal waters north of the Puget Sound district. The occurrence in large numbers in the Deadman Island Pliocene of *Pecten caurinus*, *Panomya ampla*, *Thyasira bisecta*, *Pecten hericeus*, *Lucina acutilineata*, *Natica clausa*, several species of *Trophon*, and other boreal and subboreal forms, leads to the conclusion that the strata in which they occur were deposited in water probably much colder than that which is found off shore from San Pedro at the present time. The species found fossil in the Deadman Island Pliocene, and still living at San Pedro, also offer evidence of the northern climatic conditions during later Pliocene times. Of the species living at San Pedro at the present time, and found fossil in the Pliocene, nearly all are more common toward the north. In fact, San Pedro is the southern limit of the known range of many of the species. Boreal or subboreal conditions so near the shore imply more or less similar climatic conditions on the land, at least near the ocean. This being the case, it is more than probable that during the latter part of the Pliocene epoch the climate was much colder on the coast of Southern California than it is at the present time.

---

[1] During the summer of 1901 dredging was carried on in the waters adjacent to San Pedro, Catalina Island, and San Diego, by a party of zoologists under the supervision of Dr. W. E. Ritter, of the University of California. The information obtained by the party was very important, and that regarding the mollusca was especially so to the conchologists and paleontologists of this coast, as it extended the known southern range of many species heretofore known only north of San Pedro. To Professor Raymond, who had charge of the mollusca obtained, and to Mrs. Oldroyd, who assisted in the classification of the same, the writer is indebted for much of the information regarding the offshore fauna near San Pedro.

2. PLEISTOCENE.

The Lower San Pedro Series. The lower San Pedro strata of Deadman Island and the San Pedro bluffs were deposited in water shallower than that in which most of the underlying Pliocene strata were laid down. The sediments and fauna of the lower San Pedro deposits show this. The sediments consist for the most part of medium grained gray sands such as are being deposited at the present time in about ten to twenty fathoms of water off the San Pedro shore-line. The occurrence in the lower San Pedro deposits of many species which live only between tides also offers evidence of their close in-shore deposition. The fauna of the lower San Pedro series is one of transition between the boreal or subboreal fauna of the later Pliocene and the semitropical fauna of the upper San Pedro series. Two causes account for this. First, the deposits being laid down in shallower water than that in which the Pliocene sediments were deposited would necessarily contain fewer of the colder, deeper water forms of the Pliocene; and second, the cold climatic conditions prevalent during the later Pliocene epoch were giving place to a warmer climate, which had its effect upon the boreal species which inhabited the water off San Pedro during Pliocene times.

The species found in the lower San Pedro deposits and now found living only north of San Pedro comprise 17.4 per cent. of the lower San Pedro fauna. This percentage is only a little lower than that of the northern species found in the Pliocene (the latter being 18.5 per cent.), and shows, considering the fact that the lower San Pedro beds were deposited in shallower water than that in which the Pliocene was laid down, that the climatic conditions had changed but little during the period intervening between the deposition of the Pliocene and lower San Pedro series. The evidence offered by several species (3.4 per cent. of the entire lower San Pedro fauna) which are found in the lower San Pedro series, but are now found living only south of San Pedro, shows, however, that the conditions of temperature were changing.

Besides the distinctly northern forms which either disappear or become scarce in the period between the Pliocene and lower San Pedro series, there are many species best suited for northern conditions which become rare in the lower San Pedro series, while species best suited for southern conditions begin to increase in numbers. All of the evidence shows that climatic conditions were changing from boreal towards tropical during the time of the deposition of the lower San Pedro series. That the boreal conditions still preponderated during this period, however, is shown by the fauna of the lower San Pedro.

The Upper San Pedro Series.—The deposits of the upper San Pedro series consist of coarse gravels, and sands which show alternating dune and water bedding; and the rapidly changing conditions under which the deposits were laid down is evidenced by their variation. The fauna of the upper San Pedro series is southern in character, and, as would be expected, approaches more nearly the present living fauna of the San Pedro region. Being deposited in shallower water than either the Pliocene or lower San Pedro deposits, one would expect it to contain fewer of the cold water species and more of the species found only between tides and in the warm waters of the lagoons. Such is the case, but it is a noticeable fact that in the upper San Pedro fauna 14.2 per cent. are species which are found living at the present time only south of San Pedro. Not only is this true, but of the species in the upper San Pedro fauna which are now living at San Pedro a large number are best suited for southern conditions.

Although 6.1 per cent. of the upper San Pedro fauna are found now living only north of San Pedro, these northern species are only very rarely found in the upper San Pedro deposits. On the other hand, not only are most of the southern forms common in the upper San Pedro series, but the whole fauna has a semitropical aspect. Such species as *Cardium elatum*, *Arca labiata*, *Pecten dentatus*, *Mactra exoleta*, *Venus gnidia*, *Murex leeanus*, *Eupleura muriciformis*, *Cancellaria tritonidea*, and *Bulla punctulata* give this fauna its tropical character. The evidence offered by the southern forms outweighs the evidence of the northern species in another respect, for it would require a great change in climate from the conditions prevalent during later Pliocene times to cause these southern species to migrate northward to the San Pedro region; while this same change in climate would not so visibly affect the northern species, for they could simply migrate into deep water, where the conditions would more nearly approximate the boreal. This latter has been the case with such species as *Lucina acutilineata*, *Chrysodomus tabulatus*, *Solariella cidaris* and *Solariella peramabilis*, which now inhabit northern waters, near shore, but which have been dredged in the deep water between Catalina Island and the mainland.

The evidence offered by the upper San Pedro fauna leads to the conclusion that semitropical conditions prevailed during the deposition of this formation. The similarity of the fauna of these beds with that now living at San Pedro and the adjacent coast makes it probable that the conditions, although more tropical than those of the present time, were not extremely tropical.

3. Relation of the Late Pliocene, Pleistocene, and Living Faunas of California to the Fauna of Japan.

Great similarity exists between the late Tertiary and Pleistocene marine invertebrate fauna of Japan and that of the western coast of the United States. This similarity is shown by a comparison of the species found in the uppermost Tertiary deposits in the region about Tokio and the species found in beds of similar age along the Pacific coast of North America.

Dr. Brauns[1] has described some of the formations in the vicinity of Tokio, and has given lists and descriptions of the fossils found in these formations. Dr. Brauns thinks that the deposits he has examined are of the uppermost Tertiary. His lists of fossils lead to that conclusion, if one compares them with the fauna of the later Pliocene of California. Many of the Japanese species have counterparts in species found in the San Pedro deposits. Such species, for example, as *Lucina borealis*, *Cylichna cylindracea*, and *Pecten yessoensis* are closely related, if not identical, with the west

---

[1] Geology of the Environs of Tokio. By David Brauns. Mem. Sci. Dept. Univ. of Tokio, No. 4, 1881, pp. 27, 51.

American species, *Lucina acutilineata*, *Cylichna alba*, *and Pecten caurinus*. There are many such cases of the similarity of species, and in a few instances identical species have been found which are common to the two regions. The following species are found in Dr. Brauns' list of upper Tertiary fossils from Ojai, near Tokio, which are also found in the San Pedro deposits:

List of Fossils from Ojai, which are Found in the San Pedro Deposits.

Cardium californiense [= *C. corbis*]
Crepidula aculeata
Kellia suborbicularis
Macoma nasuta
Panopæa generosa
Tresus nuttalli

Among the species now found living in Japan, and on the west American coast, and also found in the San Pedro deposits, are the following:[1]

List of Living Species Common to Japan and the West Coast of North America, which are Found in the San Pedro Deposits.

Cardium corbis
Crepidula grandis
Cryptochiton stelleri
Dentalium hexagonum
Drillia inermis
Leptothyra carpenteri
Macoma edulis
Macoma inquinata
Macoma nasuta
Macoma secta
Mytilus edulis
Natica clausa
Pecten hericeus
Purpura crispata
Panopæa generosa
Pododesmus macroschisma
Sanguinolaria nuttalli
Siphonalia kellettii
Tresus nuttalli
Tapes staminea
Tellina bodegensis
Tritonium (= Priene) oregonensis
Trophon orpheus (= T. stuarti (?))

The living faunas of the Japanese and west American coasts, though having many species in common, are not as closely related as are the upper Tertiary and Pleistocene faunas of the same regions. This has been brought about in two ways. First, the more or less close connection between the two regions, which existed in late Tertiary and early Pleistocene times, has been broken; and second, southern species from the warm China seas have migrated northward and mingled with the Japanese early Pleistocene species, while Panama species have come northward during the upper San Pedro time and changed the aspect of the fauna of the west coast of North America. Those species which Japan and the west coast of North America have in common are either circumboreal or are forms which have changed little since the habitats of the two faunas were similar and connected; those species which differ but slightly have in many cases made this change since the connection was broken; and many of the forms which occur in each fauna, and which have no counterpart in the other, have come into these faunas in comparatively recent times.

An interesting example of the migration which took place between Japan and western North America is offered by the genus *Haliotis*. This genus is of Asiatic origin, but it migrated to the northern American coast during late Pliocene or early Pleistocene times. This is shown by the absence of this species from any of the pre-Pleistocene formations along this coast. Only two fossil *Haliotidæ* have been found on this coast, one being taken from the upper San Pedro (Pleistocene) gravel of

---

[1] This list is compiled from the following papers:
Mollusks of Western North America. By P. P. Carpenter. Smithsonian Miscellaneous Collections, No. 252, 1872.
Catalogue of California Fossils. By J. G. Cooper. 7th Ann. Rept. Cal. State Mineralogist, 1888.

Deadman Island, and the other from the Pleistocene (upper San Pedro series) at Spanish Bight, San Diego. The nearly total absence of this species from even the Pleistocene deposits is accounted for by the length of time it would take the species to migrate to the California coast from Alaskan waters, where it first reached the American shore during Pliocene or early Pleistocene times. This scarcity of the *Haliotidæ*, which are so common in the living fauna, in even the upper San Pedro deposits, is more evidence in favor of the theory that a long period of time has elapsed since the deposition of the upper San Pedro series.

Dr. J. P. Smith explains the phenomena of the similarity of the late Tertiary and early Pleistocene fauna, and the somewhat similar, though diverging, living faunas in this way: during Tertiary time there was an elevation of the submarine shelf which follows the line of the Aleutian Islands. This elevation made possible the intermigration of many species which otherwise never could have crossed the abyssal gap which now separates the northwestern American and Japanese regions. After the elevation of this shelf it remained in a more or less constant position for some time, and then became deeply submerged again, with a consequent breaking of the faunal connection between the two regions.

From the evidence brought forward in this paper, it has been seen that the late Pliocene and early Pleistocene was a period of the southward extension of boreal conditions on the west American coast; it would, therefore, be natural to infer that approximately the same conditions prevalent on the Californian coast during late Pliocene times also prevailed along the Japanese coasts during the same period. A detailed study of the Tertiary and Pleistocene deposits of Japan is awaited with interest, as such a study will throw more light on the conditions prevailing on the shores of the North Pacific during the later geologic epochs.

PART II. DESCRIPTIONS OF SPECIES.

THE PLIOCENE AND PLEISTOCENE FAUNA OF SAN PEDRO AND VICINITY.

SYNOPSIS.

PAGE
CŒLENTERATA ... 86
  CLASS I. ANTHOZOA ... 86
    Family I. Turbinolidæ ... 86
      Genus Caryophyllia ... 86
        1. arnoldi VAUGHAN ... 86
        2. pedroënsis V., sp. nov. ... 87
        3. californica V., sp. nov. ... 87
      Genus Paracyathus MILNE-EDWARDS & HAIME ... 88
        4. pedroënsis V., sp. nov. ... 88
ECHINODERMATA ... 90
  CLASS II. ECHINOIDEA ... 90
  SUBCLASS EUECHINOIDEA ... 90
    ORDER DIADEMATOIDA ... 90
    SUBORDER STEREOSOMATA ... 90
    Family II. Echinometridæ ... 90
      Genus Strongylocentrotus BRANDT ... 90
        5. franciscanus A. AGASSIZ ... 90
        6. purpuratus STIMPSON ... 90
    ORDER CLYPEASTROIDA ... 91
    Family III. Scutellidæ ... 91
      Genus Scutella LAMARCK ... 91
      Subgenus Echinarachnius LESKE ... 91
        7. (E.) excentricus ESCHSCHOLTZ ... 91
MOLLUSCOIDEA ... 92
  CLASS III. BRYOZOA ... 92
        8. Sp. indet. ... 92
  CLASS IV. BRACHIOPODA ... 92
    ORDER ARTHROPOMATA ... 92
    Family IV. Terebratulidæ ... 92
      Genus Terebratalia BEECHER ... 92
        [S. B.] hemphilli DALL ... 92
        9. smithi, sp. nov. ... 93
      Genus Laqueus DALL ... 93
        10. jeffreysi DALL ... 93
    Family V. Lingulidæ ... 94
    Subfamily Lingulinæ ... 94
      Genus Glottidia DALL ... 94
        [S. B.] albida HINDS ... 94

MOLLUSCA 95
CLASS V. PELECYPODA 95
ORDER PRIONODESMACEA 95
SUPERFAMILY NUCULACEA 95
Family VI. Nuculidæ 95
Genus Nucula LAMARCK 95
Subgenus Acila H. & A. ADAMS 95
11. (A.) castrensis HINDS 95
Subgenus Nucula, *s. s.* 96
12. (N.) suprastriata CARPENTER 96
Family VIa. Ledidæ 96
Genus Leda SCHUMACHER 96
13. fossa BAIRD 96
14. hamata CARPENTER 97
15. minuta FABR., var. præcursor, var. nov 97
16. taphria DALL 98
Genus Yoldia MÖLLER 99
17. cooperi GABB 99
18. scissurata DALL 99
SUPERFAMILY ARCACEA 100
Family VII. Arcidæ 100
Subfamily Pectunculinæ 100
Genus Glycymeris DA COSTA 100
19. barbarensis CONRAD 100
20. septentrionalis MIDDENDORFF 101
Subfamily Arcinæ 101
Genus Arca (LINNÉ) LAMARCK 101
21. labiata SOWERBY 101
SUPERFAMILY OSTRACEA 102
Family VIII. Ostreidæ 102
Genus Ostrea (LINNÉ) LAMARCK 102
22. lurida CARPENTER 102
SUPERFAMILY PECTINACEA 103
Family IX. Pectinidæ 103
Genus Pecten MÜLLER 103
Subgenus Pecten, *s. s.* 103
[S. B.] (P.) bellus CONRAD 103
23. (P.) dentatus SOWERBY 104
[S. D.] (P.) hemphilli DALL 105
24. (P.) stearnsii DALL 106
Subgenus Chlamys BOLTEN 107
Section Patinopecten DALL 107
25. (P.) caurinus GOULD 107
[S. D.] (P.) expansus DALL 108
Section Nodipecten DALL 108
26. (N.) subnodosus SOWERBY 108
Section Chlamys, *s. s.* 109
27. (C.) hastatus SOWERBY 109
28. (C.) hericeus GOULD 110
29. (C.) hericeus var. strategus DALL 110
30. (C.) jordani, sp. nov 111
31. (C.) latiauritus CONRAD 111
32. (C.) latiauritus CONR., var. fragilis, var. nov 112
33. (C.) latiauritus CONR., var. monotimeris CONRAD 112
[S. D.] (C.) opuntia DALL 113
Section Plagioctenium DALL 113
34. (P.) newsomi, sp. nov 113
[S. D.] (P.) subventricosus DALL 114
35. (P.) ventricosus SOWERBY 114
Subgenus Hinnites DE FRANCE 115
36. (H.) giganteus GRAY 115

MOLLUSCA (CONTINUED.)

Family X. Limidæ 115
Genus Lima (BRUGUIÈRE) CUVIER 115
Subgenus Lima, *s. s.* 115
Section Mantellum ADAMS 115
37. (M.) dehiscens CONRAD 116
SUPERFAMILY ANOMIACEA 116
Family XI. Anomiidæ 116
Genus Pododesmus PHILIPPI 116
Section Monia GRAY 116
38. (M.) macroschisma DESHAYES 116
Genus Anomia LINNÉ 117
39. lampe GRAY 117
[S. D.] limatula DALL 118
SUPERFAMILY MYTILACEA 118
Family XII. Mytilidæ 118
Genus Mytilus (LINNÉ) BOLTEN 118
Section Mytilus, *s. s.* 118
40. (M.) edulis LINNÉ 118
Genus Septifer RECLUZ 119
41. bifurcatus REEVE 119
Genus Modiolus LAMARCK 120
Section Modiolus, *s. s.* 120
42. (M.) fornicatus CARPENTER 120
43. (M.) rectus CONRAD 120
Genus Lithophaga BOLTEN 121
44. plumula HANLEY 121
Order ANOMALODESMACEA 121
SUPERFAMILY ANATINACEA 121
Family XIII. Periplomidæ 121
Genus Periploma SCHUMACHER 121
45. argentaria CONRAD 121
Family XIV. Thraciidæ 122
Genus Thracia (LEACH) BLAINVILLE 122
46. trapezoides CONRAD 122
Family XV. Pandoridæ 123
Genus Pandora 123
Subgenus Kennerlia CARPENTER 123
47. (K.) bicarinata CARPENTER 123
48. (K.) filosa CARPENTER 124
Genus Clidiophora CARPENTER 124
49. punctata CONRAD 124
Family XVI. Lyonsiidæ 125
Genus Lyonsia TURTON 125
50. californica CONRAD 125
Genus Mytilimeria CONRAD 125
51. nuttalli CONRAD 126
SUPERFAMILY POROMYACEA 126
Family XVII. Verticordiidæ 126
Genus Verticordia S. WOOD 126
52. novemcostata ADAMS & REEVE 126
ORDER TELEODESMACEA 127
SUPERFAMILY ASTARTACEA 127
Family XVIII. Astartidæ 127
Genus Astarte SOWERBY 127
Subgenus Crassinella BAYLE 127
53. (C.) branneri, sp. nov 127
SUPERFAMILY CARDITACEA 128
Family XIX. Carditidæ 128

MOLLUSCA (Continued).

Genus Venericardia Lamarck 128
54. barbarensis Stearns 128
55. ventricosa Gould 128
Genus Lazaria Conrad 129
56. subquadrata Carpenter 129
SUPERFAMILY CHAMACEA 130
Family XX. Chamidæ 130
Genus Chama (Pliny) Linné 130
57. exogyra Conrad 130
58. pellucida Sowerby 130
SUPERFAMILY LUCINACEA 131
Family XXI. Lucinidæ 131
Genus Lucina Bruguière 131
59. acutilineata Conrad 131
60. californica Conrad 132
61. nuttalli Conrad 132
62. tenuisculpta Carpenter 133
Family XXII. Diplodontidæ 133
Genus Diplodonta 133
Section Diplodonta, *s. s.* 133
63. (D.) orbella Gould 134
64. (D.) serricata Reeve 134
Family XXIII. Cryptodontidæ 135
Genus Thyasira Leach 135
65. bisecta Conrad 135
66. gouldi Philippi 135
SUPERFAMILY LEPTONACEA 136
Family XXIV. Leptonidæ 136
Genus Bornia Philippi 136
67. retifera Dall 136
Genus Kellia Turton 136
Section Kellia Turton, *s. s.* 136
68. (K.) laperousii Deshayes 137
69. (K.) suborbicularis Montagu 137
Family XXV. Kelliellidæ 138
Genus Aligena H. C. Lea 138
70. cerritensis, sp. nov. 138
SUPERFAMILY CARDIACEA 138
Family XXVI. Cardiidæ 138
Genus Cardium (Linné) Lamarck 138
Subgenus Trachycardium Mörch 138
71. (T.) quadrigenarium Conrad 139
Subgenus Ringicardium Fischer 139
72. (R.) procerum Sowerby 139
Subgenus Cerastoderma Mörch 140
73. (C.) corbis Martyn 140
Subgenus Lævicardium Swainson 140
74. (L.) elatum Sowerby 141
75. (L.) substriatum Conrad 141
Genus Protocardia Beyrich 142
76. centifilosa Carpenter 142
SUPERFAMILY VENERACEA 142
Family XXVII. Veneridæ 142
Subfamily Venerinæ 142
Genus Tivela Link 142
77. crassatelloides Conrad 143
Genus Callista Poli 143
78. newcombiana Gabb 143
79. subdiaphana Carpenter 144
80. subdiaphana Carpenter, var. pedroana, var. nov. 144

MOLLUSCA (CONTINUED).

Subgenus Amiantis Conrad 145
81. (A.) callosa Conrad 145
Subfamily Dosininæ 146
Genus Dosinia Scopoli 146
[S. D.] ponderosa Gray 146
Genus Venus Linné 146
[S. B.] perlaminosa Conrad 146
Subgenus Chione Megerle 147
82. (C.) fluctifraga Sowerby 147
83. (C.) gnidia Sowerby 147
84. (C.) neglecta Sowerby 148
85. (C.) simillima Sowerby 148
86. (C.) succincta Valenciennes 149
Subfamily Tapetinæ 149
Genus Tapes Megerle 149
87. lacineata Carpenter 150
88. staminea Conrad 150
89. tenerrima Carpenter 151
Genus Saxidomus Conrad 151
90. aratus Gould 151
Subfamily Gemminæ 152
Genus Psephis Carpenter 152
91. salmonea Carpenter 152
92. tantilla Gould 153
Family XXVIII. Cooperellidæ 153
Genus Cooperella Carpenter 153
93. subdiaphana Carpenter 153
Family XXIX. Petricolidæ 154
Genus Petricola Lamarck 154
Section Petricola Lamarck, *s. s.* 154
94. (P.) carditoides Conrad 154
Section Rupellaria Fleurian 155
95. (R.) lamellifera Conrad 155
Section Petricolaria 155
96. (P.) denticulata Sowerby 155
97. (P.) cognata C. B. Adams 156
SUPERFAMILY TELLINACEA 156
Family XXX. Tellinidæ 156
Genus Tellina Linné 156
Subgenus Moerella Fischer 156
98. (M.) salmonea Carpenter 157
Subgenus Angulus Megerle 157
99. (A.) buttoni Dall 157
100. (A.) bodegensis Hinds 158
101. (A.) idæ Dall 158
102. (A.) rubescens Hanley 159
Genus Metis H. & A. Adams 160
103. alta Conrad 160
Genus Macoma Leach 160
Subgenus Macoma, *s. s.* 161
104. (M.) calcarea Gmelin 161
105. (M.) indentata Carpenter 161
106. (M.) inquinata Deshayes 162
107. (M.) nasuta Conrad 163
108. (M.) nasuta Conrad, var. kelseyi Dall 164
109. (M.) secta Conrad 164
110. (M.) yoldiformis Carpenter 165
Family XXXI. Semelidæ Schumacher 165

MOLLUSCA (Continued).

Genus Semele 165
111. decisa Conrad 165
112. pulchra Sowerby 166
113. pulchra Sowerby, var. montereyi, var. nov 166
Genus Cumingia Sowerby 167
114. californica Conrad 167
Family XXXII. Psammobiidæ 167
Genus Psammobia (Lamarck) Bowdich 167
Subgenus Psammobia, *s. s.* 167
115. (P.) edentula Gabb 168
Genus Sanguinolaria Lamarck 168
Section Nuttallia Dall 168
116. (N.) nuttalli Conrad 168
Genus Tagelus Gray 169
117. californianus Conrad 169
Family XXXIII. Donacidæ 169
Genus Donax (Linné) Lamarck 169
118. californica Conrad 170
119. lævigata Deshayes 170
SUPERFAMILY SOLENACEA 171
Family XXXIV. Solenidæ 171
Genus Solen Linné 171
120. rosaceus Carpenter 171
121. sicarius Gould 172
Genus Siliqua Megerle 172
122. lucida Conrad 172
123. patula Dixon, var. nuttalli Conrad 173
SUPERFAMILY MACTRACEA 174
Family XXXV. Mactridæ 174
Subfamily Mactrinæ 174
Genus Mactra Linné 174
124. californica Conrad 174
125. exoleta Gray 175
126. hemphilli Dall 175
Subgenus Spisula Gray 175
127. (S.) catilliformis Conrad 176
128. (S.) falcata Gould 176
Subfamily Pteropsidinæ 177
Genus Labiosa (Schmidt) Möller 177
Subgenus Raeta Gray 177
129. (R.) undulata Gould 177
Subfamily Lutrariinæ 178
Genus Tresus Gray 178
130. nuttalli Conrad 178
SUPERFAMILY MYACEA 179
Family XXXVI. Myacidæ 179
Genus Platyodon Conrad 179
131. cancellatus Conrad 179
Genus Cryptomya Conrad 179
132. californica Conrad 180
Family XXXVII. Corbulidæ 180
Genus Corbula (Bruguière) Lamarck 180
133. luteola Carpenter 181
Genus Neæra Gray 181
134. pectinata Carpenter 181
Family XXXVIII. Saxicavidæ 182
Genus Panopea Ménard 182
135. generosa Gould 182

MOLLUSCA (Continued).

Genus Panomya Gray 183
136. ampla Dall 183
SUPERFAMILY ADESMACEA 183
Family XXXIX. Pholadidæ 183
Subfamily Pholadinæ 183
Genus Zirphæa Leach 183
137. gabbii Tryon 184
Subfamily Jouannetinæ 184
Genus Pholadidea Goodall 184
Subgenus Pholadidea, *s. s.* 184
Section Penitella Valenciennes 184
138. (P.) penita Conrad 184
CLASS VI. SCAPHOPODA 185
Order Solenoconchia 185
Family XL. Dentaliidæ 185
Genus Dentalium Linné 185
139. hexagonum Sowerby 185
140. indianorum Carpenter 186
141. pseudohexagonum Dall 186
142. semipolitum Broderip & Sowerby 187
Genus Cadulus Philippi 187
143. nitentior Carpenter 187
CLASS VII. GASTROPODA 188
Order Opisthobranchiata 188
Family XLI. Actæonidæ 188
Genus Actæon Montfort 188
144. traskii Stearns 188
Subgenus Rictaxis Dall 188
145. (R.) punctocœlata Carpenter 189
Family XLII. Tornatinidæ 189
Genus Tornatina A. Adams 189
146. cerealis Gould 189
147. culcitella Gould 190
148. eximia Baird 190
149. harpa Dall 191
Genus Volvula A. Adams 191
150. cylindrica Carpenter 191
Family XLIII. Scaphandridæ 192
Genus Cylichna Lovén 192
151. alba Brown 192
Family XLIV. Bullidæ 193
Genus Bulla Linné 193
152. punctulata A. Adams 193
153. quoyi Gray 193
Genus Haminea Leach 194
154. virescens Sowerby 194
Order Pulmonata 194
Suborder Stylommatophora 194
SUPERFAMILY MONOTREMATA 194
Family XLV. Helicidæ 194
Genus Helix Linné 194
Subgenus Epiphragmophora Strobel 194
155. (E.) sp. indet 195
SUPERFAMILY HYGROPHILA 195
Family XLVI. Limnæidæ 195
Subfamily Planorbinæ 195
Genus Planorbis Guettard 195
156. tumidus Pfeiffer 195
157. vermicularis Gould 195

MOLLUSCA (Continued).

Family XLVII. Physidæ 196
Genus Physa Draparnaud 196
158. heterostropha Say 196
SUPERFAMILY DITREMATA 196
Family XLVIII. Auriculidæ 196
Subfamily Melampinæ 196
Genus Melampus Montfort 196
159. olivaceus Carpenter 197
SUPERFAMILY PETROPHILA 197
Family XLIX. Gadiniidæ 197
Genus Gadinia Gray 197
160. reticulata Sowerby 197
Superorder Streptoneura 198
Order Ctenobranchiata 198
SUPERFAMILY TOXOGLOSSA 198
Family L. Terebridæ 198
Genus Terebra Bruguière 198
Section Acus (Humphrey) Gray 198
161. (A.) simplex Carpenter 198
Family LI. Conidæ 199
Genus Conus Linné 199
162. californicus Hinds 199
Family LII. Pleurotomidæ 199
Genus Pleurotoma Lamarck 199
163. perversa Gabb 200
Subgenus Borsonia Bellardi 200
164. (B.) bartschi, sp. nov 200
165. (B.) dalli, sp. nov 201
166. (B.) hooveri, sp. nov 201
Subgenus Leucosyrinx Dall 202
167. (L.) pedroana, sp. nov 202
Subgenus Genota Adams 202
Section Dolichotoma Bellardi 202
168. (D.) carpenteriana Gabb 202
169. (D.) cooperi, sp. nov 203
170. (D.) tryoniana Gabb 203
Genus Drillia Gray 204
171. cancellata Carpenter 204
172. hemphilli Stearns 204
[S. D.] incisa Carpenter 205
173. inermis Hinds 205
174. inermis, var. penicillata Carpenter 205
175. johnsoni, sp. nov 206
176. merriami, sp. nov 207
177. montereyensis Stearns 207
178. pudica Hinds 208
179. renaudi, sp. nov 208
180. torosa Carpenter 209
Genus Bela Gray 209
181. fidicula Gould 209
182. sanctæ-monicæ, sp. nov 210
Genus Mangilia (Leach) Risso 210
Subgenus Clathurella Carpenter 210
183. (C.) conradiana Gabb 210
Subgenus Cythara Schumacher 211
184. (C.) brauneri, sp. nov 211
Subgenus Mangilia Risso, *s. s.* 211
185. (M.) angulata Carpenter 212
186. (M.) hooveri, sp. nov 212

MOLLUSCA (CONTINUED).

187. (M.) interfossa var. pedroana, var. nov 213
188. (M.) interlirata STEARNS 213
189. (M.) oldroydi, sp. nov 213
190. (M.) painei, sp. nov 214
191. (M.) sculpturata DALL 214
192. (M.) striosa C. B. ADAMS 215
Subgenus Taranis JEFFREYS 215
193. (T.) strongi, sp. nov 215
Subgenus Spirotropsis SARS 216
194. (S.) Pleurotoma smithi, sp. nov 216
Family LIII. Cancellariidæ 217
Genus Cancellaria LAMARCK 217
Subgenus Cancellaria, *s. s.* 217
195. (C.) cooperi GABB 217
196. (C.) crawfordiana DALL 217
197. (C.) tritonidea GABB 218
Genus Admete MÖLLER 219
198. gracilior CARPENTER 219
Family LIV. Olividæ 219
Genus Olivella SWAINSON 219
199. biplicata SOWERBY 219
200. intorta CARPENTER 220
201. pedroana CONRAD 221
Family LV. Marginellidæ 221
Genus Marginella LAMARCK 221
202. jewettii CARPENTER 221
Section Volvarina HINDS 222
203. (V.) varia SOWERBY 222
Family LVI. Mitridæ 222
Genus Mitra LAMARCK 222
204. maura SWAINSON 222
Genus Mitromorpha A. ADAMS 223
205. filosa CARPENTER 223
206. intermedia, sp. nov 223
Family LVII. Fasciolariidæ 224
Subfamily Fusinæ 224
Genus Fusus LAMARCK 224
207. barbarensis TRASK 224
208. luteopictus DALL 225
209. robustus TRASK 226
210. rugosus TRASK 226
Genus Pisania BIVONA 227
211. fortis CARPENTER 227
Family LVIII Buccinidæ 227
Genus Chrysodomus SWAINSON 227
212. rectirostris CARPENTER 228
213. tabulatus BAIRD 228
214. sp. indet 229
Genus Siphonalia A. ADAMS 229
215. kellettii FORBES 229
Genus Macron H. & A. ADAMS 230
216. kellettii A. ADAMS 230
217. lividus A. ADAMS 230
Family LIX. Nassidæ 230
Genus Nassa LAMARCK 230
218. californiana CONRAD 231
219. cerritensis, sp. nov 231
220. fossata GOULD 232
221. insculpta CARPENTER 233

MOLLUSCA (CONTINUED).

222. mendica GOULD. 233
223. mendica GOULD, var. cooperi FORBES. 234
224. perpinguis HINDS 234
225. tegula REEVE 235
226. versicolor C. B. ADAMS, var. hooveri, var. nov 236
Family LX. Columbellidæ 236
Genus Columbella LAMARCK 236
227. solidula REEVE, var. præcursor, var. nov 236
Subgenus Anachis H. & A. ADAMS 237
228. (A.) minima, sp. nov. 237
Subgenus Æsopus GOULD 237
229. (Æ.) chrysalloidea CARPENTER 237
230. (Æ.) oldroydi, sp. nov. 238
Subgenus Astyris H. & A. ADAMS 238
231. (A.) californiana GASKOIN 238
232. (A.) gausapata GOULD 239
233. (A.) gausapata GOULD, var. carinata HINDS 240
234. (A.) tuberosa CARPENTER 240
Genus Amphissa H. & A. ADAMS 241
235. corrugata REEVE 241
236. ventricosa, sp. nov 242
237. versicolor DALL 242
Family LXI. Muricidæ 243
Genus Murex LINNÉ 243
Subgenus Chicoreus MONTFORT 243
238. (C.) leeanus DALL 243
239. (C.) trialatus SOWERBY 243
Subgenus Pteronotus SWAINSON 244
240. (P.) festivus HINDS 244
Subgenus Pterorhytis CONRAD 244
241. (P.) foliatus MARTYN 245
242. (P.) nuttalli CONRAD 245
243. (P.) monoceros SOWERBY 246
Genus Monoceros LAMARCK 246
244. engonatum CONRAD 246
245. lapilloides CONRAD 247
Genus Chorus GRAY 247
246. belcheri HINDS 247
Genus Eupleura H. & A. ADAMS 248
247. muriciformis BRODERIP 248
248. muriciformis, var. curta, var. nov 249
Genus Trophon MONTFORT 249
Subgenus Boreotrophon FISCHER 249
249. (B.) cerritensis, sp. nov 249
250. (B.) gracilis PERRY 250
251. (B.) multicostatus ESCHSCHOLTZ 251
252. (B.) pedroana, sp. nov 251
253. (B.) scalariformis GOULD 252
254. (B.) stuarti SMITH 252
255. (B.) orpheus, var. præcursor, var. nov. 253
256. (B.) tenuisculptus CARPENTER 253
257. (B.) triangulatus CARPENTER 254
Genus Ocinebra LEACH 254
258. barbarensis GABB 254
259. foveolata HINDS 255
260. interfossa CARPENTER 255
261. keepi, sp. nov. 256
262. lurida MIDDENDORFF 256
263. lurida MIDD., var. aspera BAIRD 257

MOLLUSCA (Continued).

264. lurida Midd., var. cancellina Philippi 257
265. lurida Midd., var. cerritensis, var. nov. 258
266. lurida Midd., var. munda Carpenter 258
267. micheli Ford 259
268. perita Hinds 259
269. poulsoni Nuttall 260
Subfamily Purpurinæ 260
Genus Purpura Bruguière 260
270. crispata Chemnitz 261
271. saxicola Valenciennes 261
Subfamily Coralliophilinæ 262
Genus Coralliophila H. & A. Adams 262
272. nux Reeve 262
Suborder Streptodonta 262
SUPERFAMILY PTENOGLOSSA 262
Family LXII. Scalidæ 262
Genus Scala Humphrey 262
273. bellastriata Carpenter 263
274. crebricostata Carpenter 263
275. hemphilli Dall 264
276. hindsii Carpenter 264
277. indianorum Carpenter 264
278. tincta Carpenter 265
Genus Opalia H. & A. Adams 266
[S. D.] anomala Stearns 266
279. borealis Gould 266
280. crenatoides Carpenter, var. insculpta Carpenter 267
[S. D.] varicostata Stearns 267
SUPERFAMILY GYMNOGLOSSA 268
Family LXIII. Eulimidæ 268
Genus Eulima Risso 268
281. falcata Carpenter 268
282. hastata Sowerby 268
283. micans Carpenter 269
Family LXIV. Pyramidellidæ 269
Genus Turbonilla Risso 269
Section Strioturbonilla Sacco 270
284. (S.) muricata Carpenter 270
285. (S.) similis C. B. Adams 270
286. (S.) stearnsii Dall & Bartsch, sp. nov., ... 271
287. (S.) torquata Gould 271
288. (S.) torquata var. stylina Carpenter 272
Section Lancea Pease 272
289. (L.) aurantia Carpenter 272
290. (L.) tridentata Carpenter 273
291. (L.) pentalopha Dall & Bartsch, sp. nov 274
Section Pyrgiscus Philippi 274
[S. D.] (P.) auricoma Dall & Bartsch, sp. nov 274
292. (P.) latifundia Dall & Bartsch, sp. nov 275
293. (P.) tenuicula Gould 275
294. (P.) crebritilata Carpenter 276
295. (P.) subcuspidata Carpenter 277
Section Pyrgisculus Monterosato 277
296. (P.) laminata Carpenter 277
Section Pyrgolampros Sacco 278
297. (P.) lowei Dall & Bartsch, sp. nov 278
[S. D.] (P.) lowei var. pedroana Dall & Bartsch, var. nov.. 279
298. (P.) arnoldi Dall & Bartsch, sp. nov 279
299. (P.) gibbosa Carpenter 279

MOLLUSCA (Continued).

300. (P.) adleri Dall & Bartsch, sp. nov. 280
Genus Pyramidella Lamarck 280
301. (P.) conica var. variegata Carpenter 280
Genus Odostomia Fleming 281
Section Odostomia (Fleming) *s. s.* 281
302. (O.) tenuis Carpenter 281
Section Evalea A. Adams 281
[S. D.] (E.) stearnsii Dall & Bartsch, sp. nov. 282
303. (E.) gouldii Carpenter 282
Section Amaura Möller 282
[S. D.] (A.) pupiformis Carpenter 283
304. (A.) nuciformis Carpenter, var. avellana Carpenter. 283
Section Chrysallida Carpenter 283
[S. D.] (C.) diegensis Dall & Bartsch, sp. nov. 284
Section Oscilla A. Adams 284
[S. D.] (O.) æquisculpta Carpenter 284
[S. D.] (O.) grammatospira Dall & Bartsch, sp. nov. 285
Subgenus Ivara Dall & Bartsch, subgen. nov. 285
305. (I.) terricula (Carpenter) Dall & Bartsch 285
SUPERFAMILY TÆNIOGLOSSA 285
Family LXV. Tritonidæ 285
Genus Tritonium Link 285
306. gibbosus Broderip 286
Subgenus Priene H. & A. Adams 286
307. (P.) oregonensis Redfield 286
Genus Ranella Lamarck 287
308. californica Hinds 287
Family LXVI. Cypræidæ 288
Genus Cypræa Linné 288
309. spadicea Gray 288
Genus Trivia Gray 288
310. californica Gray 288
311. solandri Gray 289
Genus Erato Risso 289
312. columbella Menke 289
Family LXVII. Triforidæ 290
Genus Triforis Deshayes 290
313. adversa Montagu 290
SUPERFAMILY CERITHIACEA 290
Family LXVIII. Cerithiopsidæ 290
Genus Seila A. Adams 290
314. assimilata C. B. Adams 290
Family LXIX. Cerithiidæ 291
Genus Bittium Leach 291
315. asperum Gabb 291
316. californicum Dall & Bartsch 291
317. filosum Gould 292
318. quadrifilatum Carpenter (with evolutionary discussion of several species) 292
319. rugatum Carpenter 295
320. williamsoni, sp. nov. 295
Subgenus Styliferina A. Adams 295
321. (S.) tenuisculpta Carpenter 296
Genus Diastoma Deshayes 296
322. sp. indet. 296
Genus Cerithidea Swainson 296
323. californica Haldemann 296
Family LXX. Cæcidæ 297

MOLLUSCA (Continued).

Genus Cæcum Fleming 297
324. californicum Dall 297
325. crebricinctum Carpenter 298
326. magnum Stearns 298
Family LXXI. Vermetidæ 299
Genus Serpulorbis Sassi 299
327. squamigerus Carpenter 299
Subgenus Vermicularia Lamarck 299
328. (V.) sp. indet 299
Genus Spiroglyphus Daudin 299
329. lituella Mörch 299
Family LXXII. Turritellidæ 300
Genus Turritella Lamarck 300
330. cooperi Carpenter 300
331. jewettii Carpenter 300
Family LXXIII. Littorinidæ 301
Genus Littorina Ferussac 301
332. planaxis (Nuttall) Philippi 301
333. scutulata Gould 302
Genus Lacuna Turton 302
334. compacta Carpenter 302
335. porrecta Carpenter 303
336. solidula (Lovén) Carpenter 303
Family LXXIV. Fossaridæ 304
Genus Fossarus Philippi 304
Subgenus Isapis H. & A. Adams 304
337. (I.) fenestrata Carpenter 304
Family LXXV. Rissoidæ 304
Genus Rissoa Fréminville 304
338. acutelirata Carpenter 305
Subfamily Hydrobiinæ 305
Genus Paludestrina d'Orbigny 305
339. curta, sp. nov. 305
340. stokesi, sp. nov. 305
Family LXXVI. Calyptræidæ 306
Genus Crucibulum Schumacher 306
Section Crucibulum *s. s.* 306
341. (C.) spinosum Sowerby 306
Genus Galerus Humphrey 307
342. mammillaris Broderip 307
Genus Crepidula Lamarck 307
343. aculeata Gmelin 308
344. adunca Sowerby 308
345. dorsata Broderip 309
346. grandis Middendorff 309
347. navicelloides Nuttall 310
348. onyx Sowerby 310
349. rugosa Nuttall 311
Family LXXVII. Amaltheidæ 311
Genus Hipponyx De France 311
350. antiquatus Linn 312
351. cranioides Carpenter 312
352. tumens Carpenter 313
Family LXXVIII. Naticidæ 313
Genus Natica (Adanson) Scopoli 313
Subgenus Cryptonatica Dall 313
353. (C.) clausa Broderip & Sowerby 313
Genus Polynices Montfort 314
Subgenus Neverita Risso 314
354. (N.) recluziana Petit 314

MOLLUSCA (Continued).

Subgenus Lunatia 315
355. (L.) lewisii Gould 315
Genus Sigaretus Lamarck 316
356. debilis Gould 316
Family LXXIX. Lamellariidæ 317
Genus Lamellaria Montagu 317
357. stearnsii Dall 317
SUPERFAMILY DOCOGLOSSA 317
Family LXXX. Acmæidæ 317
Genus Acmæa Esch 317
358. depicta Hinds 317
359. insessa Hinds 318
360. instabilis Gould 318
361. mitra Esch 318
362. paleacea Gould 319
363. pelta Esch 319
364. spectrum (Nuttall) Reeve 320
Family LXXXI. Liotiidæ 320
Genus Delphinoidea Brown 320
[S. D.] coronadoensis, sp. nov 320
Family LXXXII. Phasianellidæ 321
Genus Phasianella Lamarck 321
365. compta Gould 321
Family LXXXIII. Turbinidæ 321
Genus Pachypoma Gray 321
366. inæquale Martyn 321
Genus Pomaulax Gray 322
367. undosus Wood 322
Genus Leptothyra Carpenter 322
368. bacula Carpenter 323
369. carpenteri Pilsbry 323
370. paucicostata Dall 323
Family LXXXIV. Trochidæ 324
Genus Chlorostoma Swainson 324
371. aureotinctum Forbes 324
372. brunneum Philippi 324
373. funebrale A. Adams 325
374. funebrale A. Adams, var. subapertum Carpenter 325
375. gallina Forbes 326
376. montereyi Kiener 326
Subgenus Omphalius Philippi 327
377. (O.) viridulum var. ligulatum Menke 327
Genus Thalotia Gray 327
378. caffea Gabb 327
Genus Phorcus Risso 328
379. pulligo Martyn 328
Genus Calliostoma Swainson 329
380. annulatum Martyn 329
381. canaliculatum Martyn 329
382. costatum Martyn 330
383. gemmulatum Carpenter 330
384. tricolor Gabb 331
Genus Norrisia Bayle 331
385. norrisii Sowerby 331
Genus Margarita Leach 332
386. optabilis Carpenter, var. knechti, var. nov 332
387. optabilis Carpenter, var. nodosa, var. nov 332
388. parcipicta Carpenter, var. pedroana, var. nov 333
389. pupilla Gould 333
Genus Solariella S. Wood 334

MOLLUSCA (Continued).

390. cidaris A. Adams 334
391. peramabilis Carpenter 335
Family LXXXV. Cyclostrematidæ 335
Genus Vitrinella C. B. Adams 335
392. williamsoni Dall 335
SUPERFAMILY ZYGOBRANCHIA 336
Family LXXXVI. Haliotidæ 336
Genus Haliotis Linné 336
393. fulgens Philippi 336
Family LXXXVII. Fissurellidæ 337
Subfamily Fissurellideinæ 337
Genus Lucapina Gray 337
394. crenulata Sowerby 337
Subfamily Emarginulinæ 337
Genus Fissuridea Swainson 337
395. aspera Esch 338
396. inæqualis Sowerby 338
397. murina (Carpenter) Dall 339
Genus Clypidella Swainson 339
398. bimaculata Dall 339
399. callomarginata Carpenter 340
Genus Fissurella Bruguière 340
400. volcano Reeve 340
Genus Puncturella Lowe 341
401. cucullata Gould 341
402. galeata Gould 341
SUBCLASS ISOPLEURA 342
Order Polyplacophora 342
SUPERFAMILY EOCHITONIA 342
Family LXXXVIII. Chitonidæ 342
Genus Ischnochiton Gray 342
403. regularis Carpenter 342
Genus Cryptochiton Middendorff & Gray 342
404. stelleri Middendorff 342
SUPERFAMILY OPSICHITONIA 343
Family LXXXIX. Mopaliidæ 343
Genus Mopalia Gray 343
405. ciliata Sowerby 343
ARTHROPODA 344
CLASS VIII. CRUSTACEA 344
SUBCLASS EUCRUSTACEA 344
Superorder Cirripedia 344
Order Thoracica 344
Family XC. Balanidæ 344
Genus Balanus Lister 344
406. concavus Bronn 344
Superorder Malacostraca 345
Order Decapoda 345
Suborder Brachyura 345
Family (Subtribe) XCI. Cancroidea 345
Section Cancrini 345
Genus Cancer Linné 345
407. breweri Gabb 345
VERTEBRATA 346
CLASS IX. PISCES 346
Order Elasmobranchii 346
Suborder Selachii 346
Family XCII. Trygonidæ 346
Genus Urolophus 346
408. halleri (?) Cooper 346

CŒLENTERATA.[1]

Class ANTHOZOA.[2]

Family 1. TURBINOLIDÆ.

Genus **Caryophyllia** *Lamarck*.

1. **Caryophyllia arnoldi** *Vaughan*.

PLATE III, FIGS. 4 AND 4*a*.

Caryophyllia arnoldi VAUGHAN, Proc. U. S. Nat. Mus., Vol. XXII, 1900, No. 1194, pp. 199, 200, Pl. XVI, figs. 1, 2.

The following is the original description:—

Form of corallum slightly deformed inverted cone-shaped. A basal scar present, but the coral in its later stages was evidently unattached. Base subacute, calice nearly circular in transverse outline.

Costæ very distinct, low, broad, rounded, or flattish, show no ornamentation, but the specimen is worn, and they were probably minutely granulated, There is a tendency to alternation in size, which is pronounced near the base. There is no observable epitheca. The wall is stout, solid, a distinct pseudotheca. The costæ are wide and the intercostal spaces very narrow, simply furrows, and the septa are thickened at the wall. The upper margins of the septa project very slightly above the upper limit of the corallum wall. There are four complete cycles of septa (forty-eight in all), arranged as follows: Twelve large thick septa, joined to the columella by very thick pali. The width of each palus is equal to the width of its corresponding septum; the upper margins of the palus stand about 2 mm. above the upper surface of the columella, and fully 1 mm. above the notch dividing the palus from the septal lamina. The width of the pali is about 2.5 mm. From the upper margin of the septum to the notch between septum and palus is about 4.5 mm., may be slightly greater. The inner ends of the pali are fused solidly around the columella and to it. On the septal faces are small granulations arranged in curves parallel to the upper septal margins. On the faces of the pali are granulated or serrated crests arranged in curves parallel to the upper margins of the pali. Between each pair of these larger septa are three smaller (one of the third cycle and two of the fourth). The members of the third cycle are narrow above the level of the upper termination of the columella; below this they widen, but do not seem ever to reach the columella. The members of the fourth cycle are narrow, and thin except where they arch over the walls. The columella is essential, is composed of several pieces, trabeculæ, which are firmly soldered one to another and to the inner terminations of the pali by solid basal calcareous deposit. From the upper margins of the septa to the upper termination of the columella is about 6.5 mm.; that is, the calicular fossa is about 6.5 mm. deep. The greater diameter of the upper termination is 5 mm., the lesser 3.5 mm., above whose level, as may be gathered from what preceded, the pali form a regular crown.

Dimensions.—Greater diameter of calice, 16 mm.; lesser diameter of calice, 15.3 mm.; height of corallum, 16.5 mm.; depth of fossa, about 6.5 mm.

Locality.—San Pedro Hill, San Pedro, California.

Geologic Horizon.—Pleistocene.

Type.—Cat. No. 157,509, U. S. National Museum.

---

[1] The general arrangement of the classes is that used by Eastman in Zittel's Text-Book of Paleontology.

[2] Mr. Wayland Vaughan, of the United States Geological Survey, has prepared the diagnoses of the new Anthozoa which have been found in the San Pedro deposits. These descriptions are here included in this paper.

2. **Caryophyllia pedroënsis** *Vaughan*, sp. nov.

PLATE III, FIGS. 3 AND *3a*.

Corallum cornute, transverse calicular outline broadly elliptical.

The outer surface of the specimen is worn, so that the detail of the ornamentation is destroyed, but it can be discovered that the costæ were not very prominent, and that there were twelve corresponding to twelve large septa, pronouncedly larger than the others.

The septa are in four complete cycles; the members of the first and second cycles reach the columella and are rather thick, especially around the columella; those of the third are shorter and thinner, and those of the fourth still smaller. The septa are not so thick as in *C. arnoldi*, and not so crowded as in *C. californica*. The septal faces are granulated, the granulations being much larger and with blunt ends near the columella. All the pali except one are broken off, but they appeared to exist before the twelve larger septa. The one remaining palus is broad and thin.

Calice fairly deep. Upper surface of the columella not very deeply sunken below the level of the upper edge of the pali. Columella composed of several twisted pieces.

Dimensions.—Greater diameter of calice, 13.5 mm.; lesser diameter of calice, 12 mm.; height of corallum, 25.5 mm.

Locality.—San Pedro, California.

Geologic Horizon.—Pleistocene.

Type.—From the collection of Ralph Arnold.

3. **Caryophyllia californica** *Vaughan*, sp. nov.

PLATE III, FIGS. 2 AND *2a*.

Corallum with a narrow base, the lower half slender in comparison with the diameters at the calice. The tip of the base damaged. Calice elliptical in transverse outline.

The outer surface of the corallum is scarcely costate. There are flat, indistinct, densely granulate costæ corresponding to the septa, visible especially at and just below the calicular edge. The wall is thin and fragile.

There are four complete cycles of septa and many members of the fifth. They are thin and crowded, twelve are larger than the others, and apparently these twelve bore pali on their inner terminations. The margins of the septa of the first and second cycles project slightly above the upper edge of the wall, about 1 mm.; the margins of the septa of the other cycles are not prominent. The septal faces are granulated, the granulations are low, frequently showing elongation along the courses of the septal trabeculæ; the usual arrangement in curves parallel to the septal margins also is shown. Calice fairly deep, 4.5 or 5 mm.; a distinct and rather sudden depression over the columella. Columella not greatly developed, composed of a few loosely twisted laths.

Dimensions.—Greater diameter of calice, 11.5 mm.; lesser diameter of calice, 10 mm.; height of corallum, 13 mm.

Locality.—Deadman Island, off San Pedro, California.

Geologic Horizon.—Pliocene.

Type.—From material sent by Mr. Ralph Arnold to the U. S. National Museum.

DIFFERENTIAL CHARACTERS OF THE THREE CALIFORNIAN SPECIES OF CARYOPHYLLIA.

Septa in four cycles	form cornute; twelve more prominent costæ	*C. pedroensis*
	form short, inversely subconical, costæ equal near the calice, alternating in size near base..............................	*C. arnoldi*
Septa in four complete cycles, many members of the fifth present...........	form subflabellate, costæ excepting near the calicular margin indistinct................	*C. californica*

As the descriptions and the above table show, for the differentiation of the species, especial stress is laid upon the number of the septa, the form, and the costal characters. Although each of the three species is based on a single specimen, the author does not believe it possible for intergradation to occur within the horizons from which they were collected. *C. pedroënsis* and *C. arnoldi* appear to belong in the same group (section) of the genus; but *C. californica* presents great and striking differences from each of the preceding.

Genus **Paracyathus** *Milne-Edwards & Haime.*

Verrill has described three species of *Paracyathus* from the west coast of North America, viz.: *Paracyathus caltha,*[1] *Paracyathus stearnsi,*[2] and *Paracyathus humilis.*[3] The first two species mentioned are from Monterey, California; the last mentioned is from the Pearl Islands.

Expressed in tabular form the differences between these three species are:—

Corallum .5 in.[4] or more in height; five complete cycles of septa..............	Costæ distinct only at edge of calice, below represented by rows of granules; axes of calice, .45 in./.32 in......................	*P. caltha*
	Scabrous, subequal costæ, distinct to base, near base every fourth or sixth costa more prominent; axes of calice, .72 in./.50 in....	*P. stearnsi*
Corallum only .2 in. in height; four complete cycles of septa.	Costæ feeble, except near calicular margin. Diameter of circular calice, .22 in..........	*P. humilis*

According to the diagnostic characters given by Verrill, these three species are very distinct.

4. **Paracyathus pedroënsis** *Vaughan*, sp. nov.

PLATE III, FIGS. 1 AND 1*a*.

Corallum subturbinate in shape, base damaged, apparently not especially expanded; transverse outline of calice elliptical, slightly deformed.

Costæ not prominent, but distinct from the calicular margin to the base, subequal, sometimes every third or every fifth may be slightly more prominent than those intervening, the edges usually flattish, sometimes slightly crested. Bottoms of the intercostal furrows usually flattish; granulations crowded on the costæ, and present in the intercostal furrows also.

---

[1] Proc. Bost. Soc. Nat. Hist., Vol. XII, 1869, p. 394. Trans. Conn. Acad. Sci., Vol. I, 1870, p. 537, Pl. IX, figs. 9, 9A.

[2] Proc. Bost. Soc. Nat Hist., Vol XII, 1869, p. 393; Trans. Conn. Acad. Sci., Vol. I, 1870, p. 537.

[3] Trans. Conn. Acad. Sci., Vol. I, 1870, p. 538

[4] These decimals of an inch can be computed into millimeters by reckoning .1 inch = 2.5 mm.

There are four complete cycles of septa, and many members of the fifth, but the fifth is not complete. The septal margins project very slightly above the upper margin of the corallum wall; the margins of the members of the first and second cycles, and those of the third cycle when members of the fifth are present, are slightly more prominent than the margins of the members of the higher cycles. The septal faces are densely granulated, and the granulations show a decided tendency toward elongation along the courses of the septal trabeculæ. The septa are crowded, those of the first, second, and third cycles are thick and strong; when members of the fifth cycle are present those of the fourth are quite thick, but are thinner than the older septa.

The pali are well developed, and are shown in great perfection on the type specimen. They are broad and simple, and not bilobed. Those before the septa of the first cycle are the narrowest; those before the septa of the second cycle are slightly wider, and those before the septa of the third cycle are still wider. The inner margins of the pali before the septa of the first, second, and third cycles form a crown bordering the outer edge of the columella. In those half or quarter systems in which septa of the fifth cycle are present, pali stand before the members of the fourth cycle. These pali are large, but stand back from the columella. In such cases the pali join the members of the fourth cycle to the sides of the included members of the third. When no pali are present the members of the fourth fuse by their inner margins directly to the side of the included member of the third. When members of the fifth cycle are present, they curve toward the included member of the fourth. There are no pali before the youngest septa in any given system. Margins of the pali entire.

The calice is shallow, widely open Its ends, corresponding to the ends of the longer transverse axis, are very slightly depressed. The upper surface of the columella is flat; it consists of the rounded upper terminations of a large number of papillæ. The pali, excepting those of the fourth cycle, form a crown around the columella, as has already been stated.

Dimensions.—Greater diameter of calice, 12 mm.; lesser diameter of calice, 10 mm.; height of corallum, 18+ mm.

Locality.—San Pedro, California.

Geologic Horizon.—Pleistocene.

Type.—From the collection of Ralph Arnold.

If the description first given is compared with the table showing the chief diagnostic features of Verrill's species, it will be evident that the only species with which comparison needs to be made is *P. stearnsi.* At the same time, certain striking differences between the two will be very evident. The first is one of size.

	Greater Diameter of Calice.	Lesser Diameter of Calice.	Height of Corallum.
P. stearnsi......................................	18 mm.	12.5 mm.	12.5 mm.
P. pedroënsis....................................	12 mm.	10 mm.	18+ mm.

The costæ and the number of septa are different in the two species, but a much more important difference has not yet been brought out in the discussion. Verrill says of the septa and pali in *P. stearnsi:* "The primary and secondary septa are considerably broader than the others, broadly rounded and somewhat exsert at summit, narrowed toward the base, and *divided into two or three unequal, broad, stout, paliform teeth*, which are rough and lacerately spinulose at summit. . . . . . ."[1]

---

[1] The italics are used by the author of the present paper.

As stated in the present description, the pali of *P. pedroënsis* are *not lobed and their margins are entire.*

These comparisons will show how strikingly different the present species is from any of those previously described species from the west coast of North America.

ECHINODERMATA.

Class ECHINOIDEA.[1]

Subclass EUECHINOIDEA.

Order DIADEMATOIDA.

Suborder STEREOSOMATA.

Family II. ECHINOMETRIDÆ.

Genus **Strongylocentrotus** *Brandt.*

Test symmetrical and polyporus. Amb straight, broad at the ambitus and peristome, and with broad, poriferous zones. Pairs of pores in oblique arcs, or almost transverse series of from four to ten pairs, and crowded actinally. Interporiferous areas with two vertical rows of plain, imperforate primary tubercles; secondaries and miliaries also present. Amb with two rows of primary, and four or more of secondary tubercles.

5. **Strongylocentrotus franciscanus** *A. Agassiz.*

Toxocidaris franciscana A. AGASSIZ, Bull. Mus. Comp. Zool., Vol. 1, 1863 (*fide* Clark.)

This is the large sea-urchin of the West Coast. Spines which are probably of this species have been found in the lower San Pedro series of Deadman Island. The spines of this species are distinguishable by their large size and longitudinal striations. Some of the spines found are 20 mm. long and 3 mm. in diameter.

Living.—Puget Sound; San Diego (H. L. Clark).

Pleistocene.—San Pedro (Arnold).

6. **Strongylocentrotus purpuratus** *Stimpson.*

Echinus purpuratus STIMPSON, Crustacea and Echinoderms of the Pacific Coast, 1857 (*fide* CLARK.)

Numerous spines of this small purple sea-urchin have been found in the San Pedro series. No part of the test has ever been discovered in these deposits, to the writer's knowledge. Several nearly perfect tests of this species were found in the

---

[1] The classification and generic descriptions for this class are from Eastman in Zittel's Text Book of Paleontology.

Pleistocene (lower San Pedro series) deposits at the bath-house, Santa Barbara. A nearly perfect test was also found in the upper horizon of the San Diego formation (Pleistocene(?) at Pacific Beach, near San Diego.

Living.—San Francisco; Puget Sound (H. L. Clark): San Pedro (Arnold).

Pleistocene.—San Pedro; Santa Barbara; San Diego (Arnold).

Order CLYPEASTROIDA.

Family III. SCUTELLIDÆ.

Genus **Scutella** *Lamarck.*

Test circular or subcircular in outline, sometimes undulating or notched, broadest behind ; petaloid parts of the amb unequal, well developed, nearly closed. Peristome small, central, subcircular. Periproct very small, inframarginal. Apical system central, more or less pentagonal.

Subgenus **Echinarachnius** *Leske.*

Apical system eccentric in front or behind. Periproct actinal, marginal or supramarginal.

7. **Scutella (Echinarachnius) excentricus** *Eschscholtz.*

Scutella excentrica Esch., Zool. Atlas, Pl. XX, fig. 2, 1826.

Echinarachnius excentricus Esch., Valenciennes, Voyage Venus, Pl. X, 1846;=*Scutella striatula* Con. (*fide* Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 271). Merriam, Bull. Dept. Geol., Univ. of Cal., Vol. II, 1898, p. 110; Proc. Cal. Acad. Sci., 3rd Ser., Geol., Vol. I, 1899, p. 170, Pl. XXII, fig. 8.

Test quadrate-oval in outline ; upper surface arched, summit behind the middle of the long diameter, but in front of the excentric apical system ; petals broad, open at ends ; posterior laterals wide apart, ovate in outline, one-half the length of the anterior pair ; anterior petal longer than the anterior laterals, scattered pores continue some distance beyond the end ; apical shield excentric, its distance from the posterior margin being to its distance from the anterior margin as 1 to 1.8+ : the ambulacral furrows are split up into a great number of small branches, of which the strongest pass over the margins and extend over the upper surface ; four of the strongest furrows run to the lateral petals and stretch through their median areas almost to the apical system ; those furrows not passing to the petals sometimes reach half way to the apical system.

Dimensions.—Long. 63 mm.; lat. 68 mm.; alt. 8 mm.

Specimens from the lower San Pedro series of Deadman Island, and upper San Pedro series of San Pedro and Los Cerritos were submitted to Dr. Merriam, who pronounced them typical *E. excentricus.* This is the common "Sand Dollar" of the Pacific Coast.

Living.—Alaska to San Pedro (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego; Santa Barbara (Arnold)

(?) Pliocene.—Seven Mile Beach, San Mateo County; San Fernando; (?) San Diego (Cooper): (?) San Gregorio Creek, San Mateo County (Barber).

MOLLUSCOIDEA.

Class BRYOZOA.

8. **Bryozoa** sp. indet.

Small pieces of branching bryozoa are found quite abundantly in the San Pedro series; but as no diagnoses of West Coast species are available, their generic and specific relations cannot be given. Among some material sent to Dr. Dall, and identified by him, were several specimens which he labeled "*Cupulifera* sp." These little saucer-shaped bryozoa are from the upper San Pedro deposits, at the lumber-yard, north end of the San Pedro bluff.

Class BRACHIOPODA.[1]

Order ARTHROPOMATA.

Family IV. TEREBRATULIDÆ.

Genus **Terebratalia** *Beecher.*

Shell smooth or radially plaited; dorsal valve longitudinally impressed; hinge-line straight or not much curved; beak with a flattened area on each side of the deltidium; foramen large; deltidium incomplete; loop attached to the septum.

Terebratalia obsoleta Dall is a characteristic species.

[S. B.][2] **Terebratalia hemphilli** *Dall.*

PLATE XVII, FIGS. 1, 2 AND 3.

Terebratalia hemphilli DALL. (mss.)

Shell of medium size, subcircular in outline, rather thin; brachial valve with mesial flexure concave; surface of this valve sculptured by numerous fine incremental lines, and very faintly near the apex by several radiating lines; pedicle valve mesially convex, the sculpture being as in the brachial valve.

Dimensions.—Long. 56 mm.; lat. 57 mm.; diam. 30 mm.

This species may be distinguished from *T. smithi* by its broader outline, larger foramen, and nearly smooth surface. *T. hemphilli* is a form which shows much variation both as regards its outline, degree of convexity or concavity of its valves, and its sculpture. The drawings of this species were made by Mr. J. Howard Wilson, who first discovered the species. Found in the Pliocene of Packard's Hill, Santa Barbara.

Pliocene.—Santa Barbara (Wilson; Arnold).

---

[1] The classification and generic description of this class are from Tryon's "Structural and Systematic Conchology."

[2] All species described in this paper, but not occurring in the San Pedro fauna, are designated by the initials of the locality from whence they are described.

9. **Terebratalia smithi**, sp. nov.

PLATE XVII, FIG. 9.

Shell of medium size, subcircular in outline, rather thin; brachial valve with mesial flexure concave, surface of this valve sculptured by about thirty small, rounded, radiating ridges and several prominent incremental lines; intermediate incremental lines small and inconspicuous; pedicle valve quite strongly mesially convex, the surface being sculptured as in the dorsal valve; beak with a flattened area on each side of the deltidium; foramen small. At a length of 20 mm. and before, the shell is slightly broader proportionately than in the adult.

Dimensions.—Long. 50 mm.; lat. 47 mm.; diam. 23 mm.

T. smithi resembles *T. hemphilli* Dall (mss.), but differs from that species by being much narrower in all stages of growth, having a much smaller foramen, and in being much more prominently sculptured. A large series of *T. hemphilli* collected from the Pliocene at Santa Barbara by Mr. J. Howard Wilson was compared with the type of *T. smithi*, and the specimens in every case showed the differences mentioned above. The drawings of *T. hemphilli* (Pl. XVII, figs. 1, 2, 3) were made by Mr. J. Howard Wilson from a specimen obtained at Santa Barbara, and are inserted here for comparison with the figure of the type specimen of *T. smithi*. *T. hemphilli* has been found so far only in the Pliocene of Santa Barbara.

This species and *Laqueus jeffreysi* are the only brachiopods which have so far been found in the San Pedro beds. The type specimen, the only one found, was obtained by Mrs. Oldroyd from the Pliocene of Deadman Island; it is figured in this paper, and is now in the collection of Mrs. Oldroyd.

Pliocene.—San Pedro (Oldroyd).

Genus **Laqueus** *Dall*.

Shell with the reflected portion of the loop attached by slender processes, on each side, to the hæmal processes, at or near the points where the two septal processes branch off to the septum; foramen complete.

Type, *Laqueus californicus* Koch.

10. **Laqueus jeffreysi** *Dall*.

Frenula jeffreysi DALL, Am. Nat., Vol. V., 1871, p. 55 (ismeniform stage).
Ismenia jeffreysi DALL, Am. Jour. Conch., Vol. VII, 1871, p. 65, Pl. XI, figs. 7-10.
Megerlia jeffreysi DALL, Sci. Res. Expl. Alaska, 1877, p. 48.
Laqueus californicus var. *vancouverensis* DAVIDSON, Mon. Rec. Brachiopoda, Trans. Linn. Soc., 2nd Ser., Vol. IV., 1887, p. 113, Pl. XVIII, figs. 10-13*b* (adult), (*fide* Dall).
Laqueus jeffreysi DALL, Proc. U. S. Nat. Mus., Vol. XVII, 1894, p. 725.

Shell subcircular, inflated, with the margins of the valves nearly straight; surface smooth, waxen, with close, conspicuous punctations; area marked by an incised line; deltidia wanting; the two separated parts of the area narrow and very small; beak of the hæmal valve rather prominent, smooth. Neural beak incurved, truncated, not prominent.

Dimensions.—Long. 35mm.; lat. 35 mm.; diam. 17 mm.

Distinguishable externally from *L. californicus* by thicker shell, waxen rather than ruddy coloration, and larger foramen. Specimen identified by Dr. Dall. Specimens which may be of this species are labeled "*L. californicus*" in the State Museum collection of fossils at Berkeley. Found in Pliocene of Deadman Island; two specimens, one by Mrs. Oldroyd. Found in Pliocene of Pacific Beach, near San Diego, and also in the Pliocene of Packard's Hill, Santa Barbara.

Living.—Aleutian Islands to point off Estero Bay, near San Luis Obispo, (75 to 238 fathoms) Dall.

Pliocene.—San Pedro (Arnold; Oldroyd): Santa Barbara; San Diego (Arnold).

Family V. LINGULIDÆ.

Subfamily LINGULINÆ.

Genus **Glottidia** *Dall.*

Shell linguiform, elongate, pedunculated; dorsal valve provided internally with two sharp, narrow, incurved laminæ, diverging from the beak, and extending about one-third the length of the shell; ventral valve with a mesial septum of about the same length, extending forward from the beak; anterior adductor impressions rounded; scar of post-adductor close in cavity of beak, rounded; shell smooth, perforate or imperforate.

Type, *Glottidia albida* Hinds.

[S. B.] **Glottidia albida** *Hinds.*

Lingula albida Hinds, Zool. Sulph., p. 298, Pl. XXIX, fig. 4, 1845. G. W. Sowerby, Thes. Conch., p. 393, Pl. LVII, fig. 6, 1846. Davidson, Ann. & Mag. Nat. Hist., 2nd Ser., Vol. IX, 1852, p. 377. Reeve, Conch. Icon., Monog. Lingula, Pl. I, fig. 4, 1859. E. Suess, Sitz. k. Akad. Wiss. Wien, Bd. XXXVII, 1859, p. 230. Carpenter, Brit. Assn. Rept. 1863, p. 636. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 246. Keep, West Coast Shells, p. 215, fig. 182, 1892.

Glottidia albida Hinds, Dall, Am. Journ. Conch., Vol. VI, 1870, p. 157, Pl. VIII, figs. 1-6; Proc. Phil. Acad. Nat. Sci., 1873, p. 204; Scientific Results Expl. Alaska, 1877. Davidson, Challenger Rept. (Zool.) Vol. I, 1880, p. 26; Recent Brachiopoda, Part 3, 1886, p. 221, Pl. XXVIII, figs. 2-4. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1893, p. 182.

Shell narrow; elongated, oval, linguiform, tapering at the beaks, sides almost subparallel, very slightly curved in front; rather flat, marked with concentric lines of growth; in interior of ventral valve the beak is pointed, with a small triangular-shaped thickening grooved along the middle; mesial septum extends for one-third length of valve; scars as in generic description.

Dimensions.—Long. 27 mm.; lat. 11 mm.; diam. 5.5 mm.

One perfect valve and two imperfect valves of this species were found in the Pliocene of Packard's Hill, Santa Barbara.

Living.—Monterey to Magdalena Bay, Lower California (Davidson).

Pliocene.—Santa Barbara (Arnold): San Diego well (Hemphill).

MOLLUSCA.

Class PELECYPODA.[1]

Order PRIONODESMACEA.

Superfamily NUCULACEA.

Family VI. NUCULIDÆ.

Genus **Nucula** *Lamarck.*

Shell trigonal, with the umbones turned towards the short posterior side; smooth or sculptured; epidermis olive; interior pearly; margins crenulated; hinge with prominent internal cartilage-pit, and a series of sharp teeth on each side; pallial line simple.

Type, *Arca nucleus* Lam.

Subgenus **Acila** *H. & A. Adams.*

Shell with divaricate sculpture.

Nucula divaricata Hinds is a characteristic species.

11. **Nucula (Acila) castrensis** *Hinds.*

Nucula castrensis HINDS, Proc. Zool. Soc., 1843, p. 98; Zool. Sulph., p. 61, Pl. XVII, fig. 5, 1844. H. &. A. ADAMS, Gen. Rec. Moll., Vol. II, p. 545. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192.

Acila castrensis HINDS (=*A. lyalli* BAIRD, *fide* CARPENTER, Brit. Assn. Rept., 1863, p. 644); (=*Nucula divaricata* CON.=*N. decisa* CON.=*N. conradi* MEEK, *fide* GABB, Pal. Cal., Vol. II, 1869, p. 102). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 227. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192. DALL, Trans. Wagner Inst. Sci., Vol. III, 1898, p. 572.

Shell small, trigonal, convex, of medium thickness; umbones posterior to center, turned posteriorly; anterior end longer than posterior, rounded; posterior end short, truncated; surface divaricately sculptured; hinge with prominent internal cartilage-pit and numerous sharp teeth on each side.

Dimensions.—Long. 11.5 mm.; alt. 10 mm.; diam. 8 mm.

Easily distinguishable by the hinge teeth and divaricate sculpture. Specimens identified by Dr. Dall.

Common in Pliocene, rare in lower San Pedro series, of Deadman Island and San Pedro.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold): San Fernando; San Diego well (Cooper).

(?) Miocene.—Oregon; Martinez; Griswold's, San Benito County (Cooper): Blakely, near Seattle, Washington (Arnold).

---

[1] The major classification of this class is according to that presented by Dr. W. H. Dall in Part III of the "Contributions to the Tertiary Fauna of Florida." The minor details of classification and most of the generic descriptions are from Parts IV and V of the same work. The rest of the generic descriptions are from Tryon's "Structural and Systematic Conchology."

Subgenus **Nucula** *s. s.*

Shell not divaricately sculptured.

Nucula obliqua Lam. is a characteristic species.

12. **Nucula (Nucula) suprastriata** *Carpenter.*

PLATE XVIII, FIG. 6.

(?) Nucula tenuis (non MONT.) CARPENTER, Brit. Assn. Rept. 1863, p. 644. COOPER, State Mus. Collection Catalogue.

Shell small, trigonal, convex, thin, white, pearly interior; umbones turned toward the short posterior end; posterior end sharply rounded, anterior evenly rounded; surface with numerous distinct, rounded, raised, concentric lines; interior of margin finely crenulated; hinge with small, interior cartilage-pit, and numerous sharp teeth on each side.

Dimensions.—Long. 5.8 mm.; alt. 5.2 mm.; diam. 3 mm.

This beautiful little shell is easily distinguishable by its triangular shape, numerous sharp teeth, and distinct concentric sculpture. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of San Pedro; common in the upper San Pedro series of Los Cerritos. Found also at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at Los Cerritos, and is now in the collection of Delos Arnold.

(?) Living.—Straits of Fuca to Santa Barbara; Japan (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Arnold).

Family VI. LEDIDÆ.

Genus **Leda** *Schumacher.*

Shell resembling *Nucula;* oblong, rounded in front, produced and pointed behind; margins even; pallial line with a small sinus; umbonal area with a linear impression joining the anterior adductor.

Leda pernula Mull. is a characteristic species.

13. **Leda fossa** *Baird.*

PLATE XVII, FIG. 7.

Leda fossa BAIRD, Proc. Zool. Soc., 1863, p. 71. CARPENTER, Brit. Assn. Rept., 1863, p. 644. DALL, Nat. Hist. Soc. British Columbia, Bull. No. 2. 1897, p. 7, Pl. II, figs. 3, 13.

Shell small, elongate, convex, thin; umbones anterior, turning slightly toward the posterior end, which is elongated, narrow and truncated; anterior end short and evenly rounded; sculpture nearly obsolete, a few concentric lines discernible; escutcheon long, narrow, smooth and deep-set; an elongate process on middle of interior of posterior end; hinge with small internal cartilage-pit, and numerous sharp teeth on each side.

Dimensions.—Long. 11 mm; alt. 6 mm; diam. 3.8 mm.; umbo to posterior end 7.5 mm.; to anterior end 5 mm.

Distinguishable by lack of sculpture. Specimen identified by Dr. Dall.

One specimen from lower San Pedro series of Deadman Island, which is the one figured, and which is now in the collection of Delos Arnold.

Living.—Puget Sound (Carpenter).

Pleistocene.—San Pedro (Arnold).

14. **Leda hamata** *Carpenter.*

PLATE XVII, FIG. 4.

Leda hamata Cpr., Brit. Assn. Rept., 1863, p. 644.

Shell small, elongate-trigonal, convex, thin; umbones anterior, turning slightly toward the posterior end; short, rounded anteriorly; much lengthened, narrowed and abruptly truncated posteriorly; surface sculptured by strong, concentric raised lines; a raised band, strongly transversely sculptured by continuations of the concentric ridges, passes from the umbo, around the escutcheon, to the posterior end; on the interior of the posterior end is an elongated, raised process; escutcheon deep-set, smooth.

Dimensions.—Long. 8 mm.; alt. 5 mm.; diam. 2.5 mm.; umbo to posterior end 5.5 mm.; to anterior end 4 mm.

A small species, readily distinguishable by its long, curved posterior portion, strong sculpture, smooth escutcheon, and interior posterior process. Specimen identified by Dr. Dall.

A nearly perfect, united pair from the lower San Pedro series of Deadman Island; rare; also reported from the Pliocene of Deadman Island. Pleistocene of Spanish Bight, San Diego. The specimen figured is from the lower San Pedro series, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to Catalina (Carpenter).

Pleistocene.—San Pedro (Arnold): San Diego (Arnold).

Pliocene.—Deadman Island, San Pedro (Arnold).

15. **Leda minuta** *Fabr.* var. **præcursor**, var. nov.

PLATE XVII, FIG. 6.

Shell small, trigonal, convex, thin; umbones anterior to middle and turning slightly toward the posterior side; anterior portion from umbones short and rounded; posterior portion longer, slightly depressed, produced and slightly truncated; surface sculptured by prominent, raised concentric lines; escutcheon long, narrow, slightly striated with continuation of concentric ridges; a flat sculptured band runs around escutcheon from umbo to posterior end, and on the interior of the shell at the posterior end of this band is a little elongate ridge or process; hinge with prominent internal cartilage cup and about fifteen prominent sharp teeth on each side; pallial sinus small, narrow.

Dimensions.— Long. 7.8 mm.; alt. 5 mm.; diam. 3.9 mm.; umbo to posterior end 5 mm.; to anterior end 4 mm.

Distinguishable from *L. taphria* by smaller size, truncated posterior end with process on interior at this end, comparatively coarser sculpture, straighter posterior dorsal margin, and fewer teeth. The type shows two concentric furrows, one at 2.5 mm. and the other at 4 mm. from the umbo, which are probably the result of interrupted growth. Specimens identified by Dr. Dall, who pronounced them a variety of *L. minuta* Fabr., a northern species.

Rare in lower San Pedro series of Deadman Island and San Pedro. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

16. Leda taphria *Dall.*

PLATE XVII, FIG. 5.

Leda taphria DALL, Nat. Hist. Soc. British Columbia, Bull. No. 2, 1897, p. 7, Pl. II, figs. 6 and 8 (=*cælata* HDS., 1844, not CONR., 1832; *fide* DALL, Trans. Wagner Inst. Sci., Vol. III, 1898, p. 579).

Nucula cælata HDS., Proc. Zool. Soc., 1844, p. 99; Zool. Sulph., p. 64, Pl. XVIII, fig. 13, 1844.

Leda cælata HDS., Thes. Conch., Vol. III, No. 42, figs. 95, 96. CARPENTER, Brit. Assn. Rept., 1863, p. 644. GABB, Pal. Cal., Vol. II, 1869, p. 103. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 245. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192.

Shell small, trigonal, oblong and rounded in front, produced and pointed behind; surface sculptured by numerous sharp, concentric, raised lines; umbones central, turned toward posterior end; escutcheon long, narrow and concentrically striated; hinge with prominent internal cartilage-pit, and about twenty sharp teeth on each side; pallial line with a small sinus; umbonal area with a linear impression joining the anterior adductor.

Dimensions.—Long. 19 mm.; alt. 11 mm.; diam. 8 mm.

This is the largest of this genus found in these deposits, and is easily recognized by its size, sculpture and peculiar teeth. Hinds' name, *L. cælata*, was preoccupied by a species of Conrad's, and Dall has renamed Hinds' species for that reason. Specimens identified by Dr. Dall.

Found in Pliocene of Deadman Island and Timm's Point; lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of Deadman Island, San Pedro, Crawfish George's, Los Cerritos, and Long Beach. Found also in the Pliocene of Pacific Beach, and in the Pleistocene of Spanish Bight and Pacific Beach, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Bodega Bay to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Fernando; San Diego well (Cooper): San Pedro; San Diego (Arnold).

Miocene.—Walnut Creek, Contra Costa County; Griswold's, San Benito County; San Juan Capistrano, San Diego County (Cooper).

Genus **Yoldia** *Möller.*

Shell oblong, slightly attenuated behind; compressed, gaping, smooth or obliquely sculptured, with a dark olive, shining epidermis; external ligament slight; cartilage as in *Leda;* pallial sinus deep.

Yoldia myalis Couth. is a characteristic species.

17. **Yoldia cooperi** *Gabb.*

Yoldia cooperi GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 189; Pal. Cal., Vol. II, 1869, p. 31, Pl. IX, fig. 54. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192. DALL, Trans. Wagner Inst. Sci., Vol. III, 1898, p. 594.

Yoldia impressa (not of CON., Wilkes Exped., Vol. X, p. 726, Pl. XVIII, fig. 13; nor of MEEK, Smithsonian Check-List, Mioc.); in part, GABB, Pal. Cal., Vol. II, 1869, p. 59; in part, COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 270.

Shell of medium size, oblong, pointed at one end, subcompressed, thin; surface ornamented by numerous small, concentric ribs, abrupt on the upper side, and sloping downward on the side towards the base; beaks minute, placed in advance of middle; anterior end narrow, subacuminate; concave above; posterior end broadly rounded; lunule long, narrow, deeply impressed, smooth; hinge with prominent cup-shaped cartilage-pit, with about twelve sharp teeth in front, and about fifty behind; pallial sinus large, deep and rounded.

Dimensions.—Long. 64 mm.: alt. 32 mm.; diam. 10.5 mm.; umbo to anterior end 22 mm., to posterior end 44 mm.

The largest of the Nuculidæ found in these deposits; easily distinguishable by its size, peculiar shape, and teeth. One imperfect specimen measured 83 mm. in length. The Miocene form *(Y. impressa)* is much smaller and less compressed. Specimens identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; three specimens. Found also in Pleistocene of Spanish Bight, San Diego, and Barlow's ranch, Ventura.

Living.—Santa Cruz to San Diego (Cooper): Half Moon Bay (Arnold).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego; Ventura (Arnold).

(?) Pliocene.—San Fernando (Cooper).

18. **Yoldia scissurata** *Dall.*

PLATE XVII, FIG. 13.

Yoldia scissurata DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 595.

Yoldia arctica BROD. & Sby., Zool. Jour., 1829 (not of GRAY, Parry's Voyage App., 1824, *fide* DALL, Trans. Wagner Inst. Sci., Vol. III, 1898, p. 595).

Shell rather small, oval, compressed, very thin, translucent. only slightly narrowed posteriorly; umbones minute, slightly anterior to middle, the anterior margin is evenly convex; a thin lamina runs along the anterior margin from the umbo to the end of the shell; a much narrower one also occurs on the posterior margin; surface sculptured concentrically as in *Y. cooperi* except that this incised sculpture is not in harmony with the incremental lines; hinge and teeth similar to *Y. cooperi.*

Dimensions.—Long. 20.4 mm.; alt. 10 mm.; diam. 4 mm.; from umbo to anterior end 9 mm.; to posterior end 12 mm.

This delicate little shell resembles *Y. cooperi* in many respects, but is easily distinguishable by its smaller size, more delicate shell, the peculiar way in which the sculpture crosses the incremental lines, and by its relatively broader anterior end. Probably the *Y. amygdala* Val. reported by Cooper (7th Ann. Rept. Cal. St. Min., 1888, p. 270) as occurring at Deadman Island is *Y. scissurata* Dall. Specimens identified by Dr. Dall.

Three specimens from lower San Pedro series of Deadman Island; rare. Specimens of *Y. scissurata* in the State Museum collection of fossils at Berkeley are labeled *Y. amygdala.* The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound (Carpenter).

Pleistocene.—San Pedro (Arnold.

Superfamily ARCACEA.

Family VII. ARCIDÆ.

Subfamily PECTUNCULINÆ.

Genus **Glycymeris** *Da Costa.*

Shell orbicular, nearly equilateral, smooth or radiately striated; umbones central, divided by a striated ligamental area; hinge with a semicircular row of transverse teeth; adductors subequal; pallial line simple; margins crenated inside.

Type, *Arca glycymeris* Linn.

19. **Glycymeris barbarensis** *Conrad.*

Plate XVIII, Fig. 9.

Axinea barbarensis Con., Pac. R. R. Rept., Vol. VI, 1857, p. 71, Pl. III, fig. 11; Vol. VII, 1857, p. 194, Pl. VI, fig. 3.

Axinea intermedia (not of Brod.; not of Carpenter, Brit. Assn. Rept., 1863, p. 644), of Cooper, in part, 7th Ann. Rept. Cal. St. Min., 1888, p. 230 (not of Keep, West Coast Shells, 1892, p. 169; not of Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192; not of Dall, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 608.

Shell of medium size, convex, thick, subcircular, with angular aspect at umbones caused by the anterior dorsal margin being nearly straight; posterior end rounded; anterior end angular; surface area between umbones and interior as in *G. septentrionalis.*

Dimensions.—Long. 33.3 mm.; alt. 32 mm.; diam. 22 mm.

Distinguishable from *G. septentrionalis* by wider, more trigonal shell and angular aspect of anterior extremity. This fossil form of Conrad's is separated from the living *G. intermedia* by Dr. Dall. Specimens identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro, Los Cerritos, Deadman Island and Crawfish George's. Found also in the Pleistocene of Pacific Beach, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Pleistocene.—Santa Barbara (Conrad): San Pedro (Arnold): San Diego (Arnold).

20. **Glycymeris septentrionalis** *Middendorf.*

PLATE XVIII, FIG. 10.

Pectunculus septentrionalis MIDD., CARPENTER, Brit. Assn. Rept., 1856, p. 219.

Shell of medium size, nearly circular, convex, thick; umbones central, not prominent; surface sculptured with rather faint ridges of growth and radiating grooves, which are more or less interrupted by the ridges; triangular ligamental area between umbones divaricately striated; hinge with a semicircular row of transverse teeth; muscle impressions subequal; interior of margin crenulated.

Dimensions.—Long. 30 mm.; alt. 32.2 mm.; diam. 22 mm.

Distinguishable from *G. barbarensis* by its evenly rounded outline. Differs from Carpenter's living *P. septentrionalis* var. *subobsoleta* by having larger, thicker shell, greater convexity, and more pronounced sculpture. Specimens identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's, Deadman Island and Long Beach. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Ukamok Island, Alaska coast (Carpenter).

Pleistocene.—San Pedro (Arnold).

Subfamily ARCINÆ.

Genus **Arca** *(Linné) Lamarck.*

Shell oblong, subquadrangular, gaping anteriorly or inferiorly; hinge linear, straight, formed of a large number of small pectinated teeth; ligament external, inserted upon a lozenge-shaped area between the beaks, beaks high, rather wide apart; muscular impressions very distinct; pallial impression entire.

Type, *Arca noa* Linné.

21. **Arca labiata** *Sowerby.*

PLATE XVIII, FIG. 4.

Arca labiata SBY., CARPENTER, Brit. Assn. Rept., 1856, pp. 310, 363.

Shell of medium size and thickness, arculate below, straight above, with small but prominent presocœlous beaks; anterior extremity evenly rounded; posterior extremity angular near base, a rather prominent convex angle running from beak to lower portion of the posterior extremity; right valve with twenty-eight square topped, rather narrow, radial ridges, separated by slightly narrower interspaces; cardinal area triangular, broad, faintly sculptured with parallel lines transverse to hinge line; two nearly equal series of teeth, crowded in middle, becoming slightly oblique and further separated at the distal ends; margins serrate.

Dimensions.—Long. 28 mm.; alt. 26 mm; distance between dorsal and ventral margins 20 mm.; umbo to anterior extremity 11 mm; to posterior extremity 17 mm.

This is the only *Arca* so far reported from the Pleistocene of the Pacific Coast. It has been reported by Carpenter as being one of the few species common to both the West Indian and Pacific (Panama) faunas. This species and *Hipponyx antiquatus*, which Carpenter considers equal to *H. mitrula* of the West Indian fauna, are the only two species which occur in the Pleistocene of San Pedro and the living fauna of the West Indies. These two species offer no proof of a close water connection between these two regions during Pleistocene time, for the occurrence in both regions of these two species is merely accidental, or a coincidence. The specimen described was identified by Dr. Dall.

Rare in the upper San Pedro series of San Pedro; two specimens, a right and a left valve. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Gulf of California; Central America; West Indies (Carpenter).

Pleistocene.—San Pedro (Arnold).

Superfamily OSTRACEA.

Family VIII. OSTREIDÆ.

Genus **Ostrea** *(Linné) Lamarck.*

Shell irregular, attached by the left valve; upper valve flat or concave, often plain; lower convex, often plaited or foliaceous, and with a prominent beak; ligamental cavity triangular or elongated; hinge toothless, structure subnacreous, laminated, with a prismatic-cellular substance between the margins of the laminæ.

Type, *Ostrea edulis* Linné.

22. **Ostrea lurida** *Carpenter.*

Ostrea lurida Cpr., Brit. Assn. Rept., 1863, p. 645; Jour. de Conch., Vol. XII, 1865, p. 137. Gabb, Pal. Cal., Vol. II, 1869, p. 106. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 256. Keep, West Coast Shells, p. 164, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 193. Dall, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 687.

Shell of medium size, irregular, suborbicular, ellipsoidal, or elongated; surface laminated and sometimes irregularly plaited; beak prominent; hinge toothless.

Dimensions.—Long. 35 mm.; alt. 50 mm.

Grades into two varieties, *expansa* Cpr., which is nearly circular, and *rufoides* Cpr., which is of a reddish hue on the interior. Specimen identified by Dr. Dall.

Typical form exceedingly common in the upper San Pedro series of San Pedro, Los Cerritos and Long Beach; rare in the lower San Pedro series of Deadman Island and San Pedro. Found also in Pleistocene of Twenty-sixth street and Pacific Beach, San Diego.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Benicia, Solano County; San Diego (Cooper; Arnold): San Pedro (Arnold).

Superfamily PECTINACEA.

Family IX. PECTINIDÆ.

Genus **Pecten** *Müller.*

Shell suborbicular, regular, resting on the right valve, usually ornamented with radiating ribs; beaks approximate, eared; anterior ears most prominent; posterior side a little oblique; right valve most convex, with a notch below the front ear; hinge margins straight, united by a narrow ligament; cartilage internal, in a central pit; adductor impression double, obscure; pedal impression only in the left valve, or obsolete.

Type, *Ostrea maxima* Linné.

Subgenus **Pecten** *s. s.*

Right valve moderately inflated, left valve flattish; sculpture of strong ribs with radial striation, more or less roughened by simple concentric lamellation or incremental sculpture; ears subequal.

Type, *Pecten maximus* Linné.

[S. B.] **Pecten (Pecten) bellus** *Conrad.*

PLATE XXI, FIGS. 1 AND 2.

Janira bella CONRAD, Proc. Acad. Nat. Sci. Phila., 1856, p. 312; Pac. R. R. Rept., Vol. VI, 1857, p. 71, Pl. III, fig. 16. GABB, Pal. Cal., Vol. II, 1869, Pl. XVI, fig. 20. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244; not *P. bellis* McCOY (*teste* DALL).

Pecten (Pecten) hemphilli DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p 706 (*pars. ?*).

Pecten (Pecten) bellus CON., DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 704.

Shell large, thin, inequivalve, elegantly, radiately ribbed. Left (upper) valve slightly convex, the point of greatest convexity being generally about one-fourth the distance from the apex toward the ventral margin; between this point of greatest convexity and the apex there is a deeply depressed area, the depression generally not affecting the two outer ribs on each side, which inclose the depression on the sides; surface of left valve ornamented by thirteen or fourteen prominent, flat-topped, sometimes faintly bicarinated, radiating ribs, which have flat, sloping sides; these ribs become broader, less elevated and less sharply angulated near the periphery in the adult; interspaces slightly wider than the tops of the ribs, with slightly rounded bottoms; whole surface of left disk covered with fine, sharp, concentric, regular lamellæ; ears rather small, subequal, slightly concave, finely concentrically lamellated, separated from the disk by an impressed line. Right (lower) valve prominently convex, the point of greatest convexity being about one-third the distance from the apex to the ventral margin of the disk; the umbo in this valve curves sharply and meets the plane of the ears at an angle of about ninety degrees; surface of right valve ornamented by fourteen or fifteen prominent, nearly flat-topped, square, radiating ribs, some of them with one or two longitudinal obsolete lines; the ribs become somewhat less elevated and the sides more sloping as the periphery is approached in the adult; surface of right disk ornamented with close, fine, squamose, concentric wrinkles; ears subequal, arched, covered with crowded, elevated lamellæ; byssal notch small.

Dimensions.—Alt. 80 mm.; lat. 108 mm.; diam. 32 mm.; length of hinge-line, 45 mm.

Found in the Pliocene at Santa Barbara, California (Conrad, Gabb, Yates Cooper, Arnold).

The description, measurements, and figures are of Gabb's type specimen of *Janira bella* (No. 960, Collection Academy Natural Sciences, Philadelphia), which was kindly loaned to the writer by Professor H. A. Pilsbry, Curator of Mollusca.

P. stearnsii and *P. diegensis* are distinguishable from *P. bellus* by the more numerous (25 or 28 in the first, 20 or 22 in the second), narrower, sharper defined, perpendicular-sided, radiating ribs on the right valve, and by evenly rounded, prominently and evenly lamellated ribs of the left valve. *P. hemphilli* is distinguishable from *P. bellus* by its smaller size; by having on the right valve more numerous (15 or 16 in the former), round-topped, narrower, nearly perpendicular-sided, radiating ribs, which retain their prominence for their entire length, and by the less convexity of the disk, more numerous, narrower and more elevated radiating ribs of the left valve. *P. hemphilli* has the same depression below the apex in the left valve, but the less degree of convexity of the rest of the disk lessens the prominence of the depression, which is so marked in most specimens of *P. bellus*. *P. dentatus* is distinguishable from *P. bellus* by its smaller size, greater convexity of right valve, greater concavity of left valve, greater number of ribs, and by the auxiliary ribs in the left valve.

After a careful comparison of a large series of *P. bellus* with Conrad's description and figure and Gabb's figure and type specimen, the writer has no hesitancy in adopting the synonymy given at the beginning of this article. Dall is of the opinion that Conrad's species and that of Gabb are different. This idea was probably caused by the exaggeration of the bicarination of the ribs in Conrad's figure. Several of the specimens of *P. bellus* examined by the writer show this bicarination to a greater or less degree, although as a rule the ribs are nearly smooth-topped. A large series of *P. bellus* and *P. hemphilli* show the differences enumerated in a previous paragraph to be constant for the adults. The young of both species up to an altitude of twenty millimeters are nearly identical in appearance.

23. Pecten (Pecten) dentatus *Sowerby*.

PLATE XII, FIGS. 1 AND 1*a*.

Pecten dentatus SBY., Thes. Conch., Vol. I, p. 39, Pl. XV, figs. 105, 106. DALL, Trans. Wagner Ins. Sci., Vol. III, Part 4, 1892, p. 707.

Vola dentata SBY., H. & A. ADAMS, Gen. Rec. Moll.

Janira dentata SBY. (=*J. excavata*, VAL., *fide* CARPENTER, Brit. Assn. Rept., 1863, p. 654). GABB, Pal. Cal., Vol. II, 1869, p. 104. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244 (=*P. stearnsii* DALL, in part).

Shell of medium size, subcircular, inequivalve, concavo-convex, rather thin; right valve gibbous, with twenty smooth, rounded, only moderately convex ribs, separated by very faintly channeled, narrow interspaces; surface smooth except for fine, undulating lines of growth; ears on this valve convexly bent, and separated from the disk by a deep groove; anterior ear with small byssal notch, obsoletely, radiately ribbed, and with fine incremental lines; posterior ear similar except that it lacks the notch; left valve concave, with nineteen or twenty prominent squarish ribs, which are separated by deep channeled interspaces of equal width with the ribs; a faint rounded rib runs along the middle of each of the interspaces; surface with fine undulating incremental lines; ears of this valve concave, with obsolete radiating ridges and fine lines of growth.

Dimensions.—Long. 70 mm.; alt. 67 mm.; diam. 25 mm.; hinge 35 mm.

Distinguishable from *P. hemphilli* Dall by greater convexity of the right valve, and by the greater number of ribs, *P. hemphilli* having only about fifteen ribs; distinguishable from *P. stearnsii* and *P. diegensis* Dall by greater convexity of right valve, low rounded ribs rather than square ones on this valve; and by square ribs, between which are faint rounded riblets, rather than sharply rounded ribs on the left valve. *P. dentatus* is of the same shape as the Japanese species *P. laqueatus* Sby., which has fewer, but squarer, broader ribs on the right valve. This last species has been reported from the Tertiary of Japan by Dr. Brauns in his Geology of the Environs of Tokio.[1] "*P. laqueatus* has been erroneously cited by Reeve from California" (Dall).

An almost perfect right valve of this beautiful southern shell was found in the upper San Pedro series of San Pedro. It differs from a living specimen from the Gulf of California by having twenty rather than twenty-three ribs, and by having slightly less convex ribs and wider interspaces. In degree of convexity and in its ears it agrees exactly with the living shell. The specimen was identified by Dr. Dall.

Cooper has mistaken the flat valve of *P. stearnsii* for this species. A specimen in the State Museum collection at the University of California, Berkeley, labeled "*Janira dentata* Sby., San Pedro, Quaternary," is a *P. stearnsii* from the Pliocene of Deadman Island.

The specimen figured is a living shell from the Gulf of California, and is now in the collection of the Department of Geology, Leland Stanford Junior University.

Living.—Gulf of California (Carpenter; Button).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—San Diego well (Cooper)—(probably *P. hemphilli*).

[S. D.] **Pecten (Pecten) hemphilli** *Dall.*

Pecten hemphilli DALL., Proc. U. S. Nat. Mus., Vol. I, 1879, p. 15. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 257. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 706. Not *Janira bella* CON., Pac. R. R. Rept., Vol. VI, 1857, p. 71, Pl. III, fig. 16; nor GABB, Pal. Cal., Vol. II, 1869, Pl. XVI, fig. 20.

Shell of medium size, thin, inequivalve. Upper (left) valve flat or slightly concave, with a concave depression between middle of valve and umbo; surface of this valve sculptured by sixteen or seventeen very prominent, rather narrow radiating ribs, which are nearly flat-topped and have nearly perpendicular sides; interspaces wider than ribs, with rounding bottoms; fine incremental lamellæ cover the surface of this valve; ears square-cornered and concave, covered with incremental lamellæ. Lower (right) valve convex, most apparent between middle of valve and umbo; sculptured by sixteen prominent squarish ribs, which are similar to those on the upper valve, except that they are slightly broader and have a more rounded top; whole surface sculptured by very fine incremental lines; ears similar to those of upper valve except convex, and the right one having three or four radiating ridges and a small byssal notch.

---

[1] Mem. Univ. Tokio, No. 4, 1881, p. 48, Pl. VII, fig. 31.

Dimensions.—Long. 63 mm.; alt. 56 mm.; diam. 15 mm.; hinge-line 28 mm.

This species is readily distinguishable from *P. stearnsii* and *P. diegensis* by its smaller size, greater convexity of lower valve, and fewer ribs. Distinguishable from *P. bellus* by smaller size, flat or concave upper valve, and narrow, more elevated and prominent radiating ribs. Common in the upper horizon of the Pliocene at Pacific Beach, and also in the strata exposed on Tenth Street, near Russ School, San Diego.

Pliocene. Pacific Beach and Russ School, San Diego (Hemphill; Dall; Arnold).

24. Pecten (Pecten) stearnsii *Dall.*

PLATE XII, FIG. 3.

Pecten stearnsii DALL., Proc. U. S. Nat. Mus., Vol. I, 1878, p. 14; Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 706, Pl. XXVI, fig. 5.

Janira dentata SBY. (?), GABB, Pal. Cal., Vol. II, 1869, p. 104 (in part). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244 (in part).

Shell of medium size, subcircular, inequivalve, concavo-convex, thin; right valve slightly convex, with about twenty-six regular, even, square ribs, separated by channeled interspaces somewhat narrower than the ribs; the top surface of each rib is flattened with a broad, shallow groove in the middle, with one or two faint riblets on each side of the groove; whole surface covered with concentric lamellæ which are much finer and about twice as crowded as those of the left valve; left valve flattened or concave, with about twenty-four regularly rounded, vaulted, even ribs, separated by slightly wider channeled interspaces; the whole surface covered with fine, sharp, concentric, regular lamellæ, a little looped backward over the tops of the ridge; ears of this valve concave, with obsolete radiating ridges, and fine, concentric lamellæ; ears of right valve subequal, arched, covered with crowded, elevated lamellæ; byssal notch very small.

Dimensions.—Long. 71 mm.; alt. 62 mm.; diam. 14 mm; hinge 25 mm.

"This is the Pliocene precursor of *P. diegensis* Dall (Plate XII, fig. 5), (*P. floridus* of Hinds, not of Gmelin) from which it differs by having five or six more ribs, which, in the adult, have a conspicuous median sulcus." (Dall.) Mrs. Oldroyd has eight *P. diegensis* which have been hauled up in the fishermen's nets at San Pedro; two of these are over six inches in diameter and are exceptionally high colored for this species.

Two imperfect left valves from the Pliocene of Deadman Island. The figure is of a left valve from the Pliocene of San Diego. Specimens identified by Dr. Dall.

Pliocene. San Pedro (Arnold): San Diego (Pacific Beach, lower horizon), (Dall; Hamlin; Hemphill; Arnold).

Subgenus **Chlamys** *Bolten.*

Valves moderately inflated, subequal, in general similar (except in color); sculpture of radial ribbing with or without *Camptonectes* striation, with or without an imbricate surface layer; frequently spinose on the ridges; ears often discrepant, the posterior smaller.

Type, *Pecten islandicus* (Müller).

Section *Patinopecten Dall.*

Valves with small ribs, flat on the right valve and sometimes dichotomous; smaller and more rounded on the left valve; concentric sculpture inconspicuous; radial striæ absent or obsolete; ears subequal; valves nearly equilateral.

Type, *Pecten caurinus* (Gld.).

25. **Pecten (Patinopecten) caurinus** *Gould.*

PLATE XIII, FIG. 6.

Pecten caurinus GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1850, p. 345; Wilkes Expl. Exped., Vol. XII, 1852, p. 458, fig. 569. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 193; = *P. yessoënsis* CPR., (non JAY, 1856); = *P. propatulus* CARPENTER (non CONRAD, 1849) (*fide* DALL., Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 710).
Amusium caurinum GLD., CARPENTER, Brit. Assn. Rept., 1863, p. 645. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 228. KEEP, West Coast Shells, p. 168, 1892.

Shell large, nearly circular, flat inequivalve, rather thin; right valve with twenty strong, flat-topped, smooth, squarish ribs, with interspaces wider than the ribs; left valve less convex than right, with seventeen rather acutely rounded ribs, with wide, shallow interspaces; surface of left valve sculptured by regular, fine, undulating, concentric lines; ears not large, obliquely truncated at ends.

Dimensions.—Long. 110 mm.; alt. 110 mm.; diam. 16 mm.; hinge 46 mm.

This large, flat *Pecten* is distinguishable from the others of this genus found in these deposits by its size and shape. *P. expansus* Dall differs from this species by having twenty-five to thirty dichotomous ribs. *P. yessoënsis* from Amori, Rikonoken, Japan, differs from *P. caurinus* by having a more convex shell, wider, lower, more rounded ribs on the right valve, less prominent ribs on the left valve, and by having larger ears, which are truncated more nearly at right angles at the ends. *Pecten propatulus* Conrad is more convex and has fewer but stronger ribs and narrower interspaces on the right valve. Specimens identified by Dr. Dall.

Common in the Pliocene of Deadman Island and Timm's Point; rarer in the lower San Pedro series of Deadman Island and San Pedro. Also found in Pleistocene on beach near bath-house and in Pliocene at Packard's Hill, Santa Barbara. The specimen figured is from the Pliocene of Deadman Island and is now in the collection of Delos Arnold.

Living.—Puget Sound (Carpenter).

Pleistocene.—Santa Barbara; San Pedro (Cooper; Arnold).

Pliocene.—Eagle Prairie, Humboldt County; San Fernando (Cooper).

[S. D.] Pecten (Patinopecten) expansus *Dall.*

Pecten expansus DALL, Proc. U. S. Nat. Mus., Vol. I, 1879, p. 14; Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 706.

Shell large, thin, slightly convex; outer surface of upper (left) valve marked by sixteen to twenty sharp radiating ridges, but slightly elevated, and whose sides shade off insensibly into the broad interspaces; faint indications of ridges appear between the principal ones; surface of upper valve covered with fine, slightly raised, sharp lamellæ; lower (right) valve with twenty or thirty dichotomous ribs, flattened above, but not sharply differentiated from the interspaces, sculptured with fine lines of growth, with faint appearances of radiating striæ; ears rather small, and distinctly but not strongly marked off from the disk; byssal notch rounded, moderately deep.

Dimensions.—Long. 140 mm.; alt. 135 mm.; diam. 32 mm.; hinge-line 65 mm.

This species is close to *P. caurinus*, but may be distinguished by the dichotomous ribs on the lower valve, and the faint ribs between the principal ones on the upper. A species of *Pecten* near, if not identical, to *P. expansus* is found in the Pliocene near Purisima, San Mateo County, California. *P. expansus* is common in the lower horizon of the Pliocene at Pacific Beach, near San Diego.

Pliocene.—Pacific Beach, San Diego (Hemphill; Dall; Hamlin; Arnold).

Section *Nodipecten Dall.*

Both valves convex, usually of large size and heavy; ribs intermittently nodose, with more or less prominent hollow nodes or bullæ; radial striation pronounced; ears unequal, the posterior smaller; the valves often more or less oblique; imbricate surface layer sometimes very marked.

Type, *Pecten nodosus* Linné.

26. Pecten (Nodipecten) subnodosus *Sowerby.*

Pecten subnodosus SBY., Proc. Zool. Soc., 1835, p. 109. CARPENTER, Brit. Assn. Rept., 1856, p. 311; Brit. Assn. Rept., 1863, p. 621. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 710.
Pecten intermedius CON., Am. Jour. Conch., Vol. III, 1867, p. 7.

Shell large, suboval, convex; surface sculptured with numerous high, square ribs, three or four of which are generally more prominent than the others; interspaces deeply channeled, averaging about equal in width with the ribs; surface, including the ribs and interspaces, sculptured by fine radiating, squamose ridges, and fine lines of growth; ears rather small, sculptured in same manner as the disk.

Dimensions.—Long. 120 mm.; alt. 125 mm.; diam. 45 mm.

This large tropical species is distinguishable by strong elevated ribs and peculiar squamose, radiating ridges. Dr. Dall says of this species: "There seems to be little reason for separating this form from the *P. nodosus* of the Antilles. Both vary through a strictly analogous series of mutations."

One-half of a large left valve was found in the upper San Pedro conglomerate of Deadman Island by Dr. A. A. Wright, who also found a young specimen of the same species in the upper San Pedro series of San Pedro.

Living.—Lower California to Panama (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold): Cerros Island and Lower California (Dall).

Section *Chlamys s. s.*

Ribs small and numerous, imbricate or spinose; valves subequal, similar, oblique, or with unequal ears, the posterior smaller; *Camptonectes* striation and imbricate surface layer usually present; shell usually solid and opaque; byssal notch and ctenolium present.

Type, *Pecten islandicus* (Müller).

27. **Pecten (Chlamys) hastatus** *Sowerby.*

PLATE XI, FIGS. 4 AND 4*a*.

Pecten hastatus SBY., Thes. Conch., 1843, p. 72, Pl. XXII, fig. 236 (not of CARPENTER, Brit. Assn. Rept., 1863, p. 645 = *P. hericeus* GLD.); (? not of GABB, Pal. Cal., Vol. II, 1869, p. 104); (? not of COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 257). DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 708.

Shell similar in shape and general characteristics to *P. hericeus.* Left valve sculptured with eight to ten prominent, narrow, convex, coarsely spinose, radiating ribs separated by interspaces several times wider than the ribs; interspaces ornamented with fasciculi of small spinose ribs, which in some cases have only the importance of spinose lines; anterior ear large, acutely pointed, with three or four prominent, spinose, radiating ribs; right valve with eight to ten pairs of equally prominent, coarsely spinose ribs, each pair separated from the next by deep rounded interspaces along the bottoms of which run fine spinose lines; the members of each pair of ribs separated from each other by interspaces about as wide as one rib, and also ornamented with spinose lines; anterior ear with four or five strong spinose ribs and separated from disk by deep notch; posterior ears nearly obsolete, radiately spinose.

Dimensions.—Long. 54 mm.; alt. 61 mm.; diam. 21 mm.; hinge 28 mm.

Distinguishable from *P. hericeus* by the less numerous, but more prominent and more strongly spinose radiating ribs. Dr. Dall[1] says that Carpenter confused *P. hericeus* with *P. hastatus*, and as Gabb and Cooper have probably used Carpenter's *P.* "*hastatus*" as their type, their localities for that species would come under *P. hericeus.*

Mrs. Oldroyd has a beautiful pair of *Pecten hastatus* which was taken from a fisherman's net at San Pedro. Dr. Dall identified this shell and said that it was the first genuine *P. hastatus* that had ever been found at San Pedro. This species is a northern form.

Rare in Pliocene and lower San Pedro series of Deadman Island; one specimen from upper San Pedro series of Crawfish George's. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold. Found also in the Pliocene at Packard's Hill, Santa Barbara, and Pacific Beach, San Diego; and in the Pleistocene at the bath-house, Santa Barbara.

Living.—San Pedro (Oldroyd; Raymond).

Pleistocene.—San Pedro; Santa Barbara (Arnold).

Pliocene.—San Pedro; Santa Barbara; San Diego (Arnold).

---

[1] Trans. Wagner Inst. Sci., Vol. III, 1898, p. 708.

28. Pecten (Chlamys) hericeus *Gould.*

PLATE XI. FIG. 2.

Pecten hericeus GOULD, Proc. Bost. Soc. Nat. Hist. Vol. III, 1850, p. 345; Wilkes Expl. Exped. Vol. XII, 1852, p. 457, fig. 580. DALL, Trans. Wagner Inst. Sci. Vol. III, Part 4, 1898, p. 708.

Pecten hastatus ? CARPENTER, Brit. Assn. Rept. 1863, p. 645 (not of SOWERBY, Thes. Conch., 1842). ? GABB, Pal. Cal. Vol. II, 1869, p. 104. ? COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 257.

Shell of medium size, triangular ovate, compressed, equivalve, thin; surface of left valve sculptured by about fourteen to sixteen groups of fasciculated ribs, the groups being more prominent and containing more ribs as the middle of the shell is approached; the surface of all the ribs roughened by numerous rather small, erect, arched spines; right valve nearly the same as left; anterior ear of left valve large, acutely pointed, with seven to eight sharp, squamosely striated radiating ribs; posterior ear nearly obsolete; ears of right valve the same except that a deep byssal notch separates anterior ear from disk; sides of umbo rise abruptly from ears.

Dimensions.—Long. 50 mm.; alt. 47 mm.; diam. 12 mm.; hinge 19 mm.

This species resembles *P. hastatus* in shape and general characteristics. In *P. hastatus* there are seven to ten strong, narrow, prominent ribs, coarsely spinose, while in *P. hericeus* the ribs occur in fourteen to sixteen fasciculi, each fascicle consisting of three or four nearly equally prominent, finely spinose ribs, and forming a convex ridge. Specimens identified by Dr. Dall.

Rare in Pliocene of Deadman Island. The specimen figured is from that horizon and is now in the collection of Delos Arnold. Found rarely in the Pliocene of Pacific Beach, San Diego.

Living.—Straits of Fuca (Gould); ? Sitka to Santa Barbara (Cooper).

Pleistocene.—San Diego (Dall); ? Santa Barbara to San Diego (Cooper); San Pedro (Arnold).

Pliocene.—San Pedro (Arnold); ? Santa Barbara; San Fernando; San Diego well (Cooper); San Diego (Arnold).

29. Pecten (Chlamys) hericeus var. strategus *Dall.*

PLATE XI. FIG. 3.

Pecten hericius var. *strategus* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 709.

Shape and general texture same as *P. hericeus.* "The fasciculi of the left valve, to the number of five to seven, with the riblets coalescent, forming large, smooth-backed, turgid ribs, with smaller muricate intercalary threads. The large ribs sometimes break up suddenly into the usual small riblets near the base. The recent specimens are bright scarlet." (Dall). The right valve of a young from the Pleistocene of Deadman Island shows nine fasciculi, most of which seem to be made up of two riblets which keep their individuality to the umbo, instead of coalescing; the interspaces are slightly narrower than the fasciculi. The anterior ear of this right valve is prominent and ornamented with six radiating ribs, and near the disk, by elevated lines of growth; byssal notch rather deep; whole surface ornamented with minute lattice-like sculpture.

Dimensions.—Long. 19 mm.; alt. 21 mm.; diam. 5.2 mm.; hinge 9.4 mm.

Distinguishable by the few prominent, rounded ridges, and smooth surface, except for minute sculpture. Specimens identified by Dr. Dall.

Two specimens from the lower San Pedro series of Deadman Island, one of which is figured, and is now in the collection of Delos Arnold.

Living.—Unalaska (Dall).

Pleistocene.—Alaska (Dall); San Pedro (Arnold).

30. Pecten (Chlamys) jordani, sp. nov.

Plate III, Figs. 6 and 7.

Shell of medium size, shape of *P. hericius*; inequivalve, rather flat; right valve with twenty-five to thirty angular, smooth-topped, imbricated ribs, which become dichotomous after reaching a length of about 50 mm.; interspaces deeply channeled and narrower than ribs; anterior ear imperfectly radially ribbed with six ridges, and showing elevated imbricating [illegible] lines; posterior ear nearly obsolete, showing four ribs; byssal notch not deep; left valve shows twenty-five to thirty narrow, rounder ribs, showing imbrications only slightly; interspaces as large as ribs; after a diameter of about 50 mm. has been reached by the shell, small riblets appear in the widening interspaces; anterior ear shows five narrow, imbricated ridges, with wide interspaces; both valves show a tendency to contract suddenly at the basal margin upon nearing completion of growth; surface of both valves covered with a minute lattice-like sculpture, which is generally worn off on exposed portions of the shell.

Dimensions.—Long. [illegible] mm.; alt. [illegible] mm.; diam. [illegible] mm.; hinge [illegible] mm.

Allied to *P. strategus* Dall, but having fewer ribs on disk and ear, and having dichotomous ribs after reaching a diameter of 50 mm. Distinguished from *P. hericius* and *P. hastatus* by not having imbricated nor spinose ribs.

Rare in Pliocene of Deadman Island and lower San Pedro series of Deadman Island. Found also in Pliocene of Packard's Hill and Pleistocene of [illegible], Santa Barbara.

The specimen figured is the type, which is from the Pliocene of Deadman Island and is now in the United States National Museum.

Pleistocene.—San Pedro, Santa Barbara (Arnold).

Pliocene.—San Pedro, Santa Barbara (Arnold).

31. Pecten (Chlamys) latiauritus Conrad.

Plate III, Figs. [illegible]

Pecten latiauritus Conr., Jour. Phil. Acad. Sci., Vol. VII, [illegible], p. [illegible], Pl. XVIII, fig. [illegible]. Reeve, Conch. Icon., Pl. [illegible], sp. [illegible]. Sowerby, Thes. Conch., Pl. [illegible], p. [illegible]. Carpenter, Brit. Assn. Rept., [illegible], p. [illegible]. Cooper, 7th Ann. Rept. Cal. St. Min., [illegible], p. [illegible]. Keep, West Coast Shells, p. [illegible], [illegible]. Williamson, Proc. U. S. Nat. Mus., Vol. XV, [illegible], p. [illegible]. = *P. tunica* Phil., [illegible]. = *P. [illegible]* [illegible], [illegible]. Dall, Trans. Wagner Inst. Sci., Vol. III, Part [illegible], [illegible], p. [illegible].

Shell small, [illegible], inequivalve, [illegible], compressed, thin; surface ornamented with from twelve to fifteen squarish, elevated, distinct ribs with about equal, channeled interspaces; ribs often medially grooved; hinge line wide; the ears pointed above.

Dimensions.—Long. [illegible] mm.; alt. [illegible] mm.; diam. [illegible] mm.; hinge [illegible] mm.

This is the type form and is distinguishable by acutely pointed ears, distinct, squarish ribs and wide shell. Specimens identified by Dr. Dall.

Common in upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's, Deadman Island, San Pedro, and Long Beach; rare in lower San Pedro series of Deadman Island and San Pedro. Found also at Spanish Bight and Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Carpenter).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold): San Pedro; San Diego (Dall): San Diego (Arnold).

32. **Pecten (Chlamys) latiauritus** *Con.*, var. **fragilis**, var. nov.

PLATE XII, FIG. 8.

Shell of same general type as *P. latiauritus.* More compressed and much thinner; ribs seven to nine, very low and rounded, with shallow, rounded interspaces; surface smooth, the concentric sculpture being nearly obsolete; hinge long, ears sharply pointed.

Dimensions.—Long. 26 mm.; alt. 26 mm.; diam. 78 mm.; hinge 25 mm.

Distinguishable from var. *flucicolus* Dall, which it resembles, by having a longer hinge-line and pointed ears.

Rare in upper San Pedro series of San Pedro and Los Cerritos. The specimen figured is the type, which is from the upper San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

33. **Pecten (Chlamys) latiauritus** *Con.*, var. **monotimeris** *Con.*

PLATE XII, FIGS. 4 AND 4*a*.

Pecten monotimeris CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 233, Pl. XVIII, fig. 10. CARPENTER, Brit. Assn. Rept., 1863, p. 645. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 257. KEEP, West Coast Shells, p. 167, fig. 140, 1892.

Pecten latiauritus var. *monotimeris* CON., DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 709.

Shell resembling *P. latiauritus*, but more oblique, inflated, and markedly shorter, with smaller ears.

Dimensions.—Long. 19 mm.; alt. 20 mm.; diam. 9 mm.

Rare in lower San Pedro series of Deadman Island and San Pedro, and in upper San Pedro series of Los Cerritos, San Pedro, Long Beach, and Crawfish George's. Found also in Pleistocene of Spanish Bight, San Diego, and Barlow's ranch, Ventura. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Dall).

Pleistocene.—Santa Barbara; San Pedro (Dall): San Pedro; San Diego; Ventura (Arnold).

[S. D.] Pecten (Chlamys) opuntia *Dall.*

Pecten (Chlamys) opuntia DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 707, Pl. XXIX, fig. 6.

Shell of medium size, allied to *P. hericeus* var. *navarchus* Dall, from which it differs by its smaller and not fasciculated radial ribs, more elongated anterior ear, more densely, radially costate posterior ear, small size when adult, and by a tendency to be suddenly contracted at the basal margin on the completion of growth.

Dimensions.—Long. 32.5 mm.; alt. 35 mm.

This species is distinguishable from the allied species by the large number (forty or fifty) of unfasciculated imbricated ribs, which are of about equal prominence.

Found in the Pliocene at Pacific Beach, near San Diego, and in the Pliocene at Packard's Hill, Santa Barbara.

Pliocene.—Santa Barbara (Arnold): San Diego (Hemphill; Hamlin; Arnold).

Section *Plagioctenium Dall.*

Shell thin, orbicular, with subequal inflated valves, usually equilateral, with uniform, well-marked radial, not dichotomous ribs; the concentric sculpture in looped lamellæ; the ribs strong, frequently smooth above; the submargins impressed below the subequal auricles; the valves well inflated, with a tendency to oblique growth in the adult.

Type, *Pecten ventricosus* Sowerby.

34. Pecten (Plagioctenium) newsomi, sp. nov.

PLATE XI, FIGS. 1 AND 1*a*.

Shell of medium size, ovate-triangular, compressed, equilateral, rather thin; twenty-two stout, smooth-topped, squarish ribs, with channeled interspaces of same width as ribs; interspaces and sides of ribs showing sharp imbricating lines of growth; ears of left valve subequal, with subacute corners; surface of ears radially striated, and showing sharp incremental lines.

Dimensions.—Long. 24 mm.; alt. 26 mm.; diam. 8 mm.; hinge 16 mm.; angle of dorsal margins 87 degrees.

This variety is distinguishable from *P. ventricosus* by the much smaller angle (87 degrees) made by the dorsal margins of the disk, that of a typical *P. ventricosus* being about 110 degrees. *P. newsomi* is also very much less ventricose than the latter, and has much narrower ridges, wider interspaces, and a thinner shell; distinguishable from *P. subventricosus* by much smaller angle formed by dorsal margins, and by narrower ridges. It resembles *P. subventricosus* in degree of convexity. This species is named in honor of Dr. John F. Newsom, of Leland Stanford Junior University.

Rare in upper San Pedro series of San Pedro and Los Cerritos. The specimen figured is the type, which is from the upper San Pedro series at Los Cerritos, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

[S. D.] **Pecten (Plagioctenium) subventricosus** *Dall.*

Pecten (Plagioctenium) subventricosus DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 707, Pl. XXIX, fig. 8.

"Shell of the type of *P. ventricosus* Sby., from which it differs by being smaller and less tumid, less expanded laterally, with the ribs rounded, instead of flattened, above, and with narrow interspaces; the tops of the ribs smooth, the sides with a dense fringe of concentric lamellæ." (Dall).

Dimensions.—Long. 65 mm.; alt. 65 mm.; diam. 24 mm.

Several specimens of this species were found in the Pliocene of Pacific Beach, near San Diego.

Pliocene.—Ventura County (Bowers): San Diego (Hemphill; Stearns; Arnold).

35. **Pecten (Plagioctenium) ventricosus** *Sowerby.*

PLATE XI, FIGS. 3, 3*a*, 6 AND 6*a*.

Pecten ventricosus SBY., Thes. Conch., *Pecten*, 1843, p. 51, Pl. XII, figs. 18, 19. GABB, Pal Cal., Vol. II, 1869, p. 104. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 258. = *P. tumidus* SBY., 1835 (not of TURT., 1822, nor of ZEITEN, 1830) = *P. circularis* SBY. (*ex parte*) = *P. inca* D'ORB., 1847 (*fide* DALL., Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 710).

Shell thin, orbicular, with subequal inflated valves which are subequilateral; uniformly radiately ribbed; about twenty-two strong, angular, even ribs separated by narrow interspaces; the whole surface covered with fine, sharp, concentric, looped lamellæ, which exhibits the oblique growth in adult shells; ears moderately small, nearly equilateral in left valve; byssal notch prominent; surface of ears ornamented with fine concentric lamellæ of growth, and sometimes with radiating ridges.

Dimensions.—Long. 59 mm.; alt. 50 mm.; diam. 32 mm.; hinge 31 mm.; angle of dorsal margin 110 degrees.

P. æquisulcatus Carpenter resembles this species very closely, but is thinner and flatter and has narrower ribs. Probably all the Pleistocene forms would come under the head of *P. ventricosus*, but many of them have been labeled *P. æquisulcatus*. Specimens identified by Dr. Dall.

Figures 6 and 6*a*, Plate XI, represent a shell which was found in the upper San Pedro series at San Pedro, and which is probably a variety of *P. ventricosus*.

Very common in the upper San Pedro series of San Pedro, Long Beach, Los Cerritos, Crawfish George's, and Deadman Island. Found also in Pleistocene on Old Mission ditch, north of Ventura, and in the Pleistocene at Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to west tropical America (Dall).

Pleistocene.—San Pedro; San Diego; Lower California (Hemphill; Stearns; Orcutt: and Cooper): San Pedro; Ventura; San Diego (Arnold).

Subgenus **Hinnites** *Defrance.*

Shell (up to advanced youth) a typical *Chlamys*, later becoming sessile and irregular, in which stage the resilial pit is elongated and the cardinal margin develops an obscure area.

Type, *Hinnites cortezi* Defr.

36. **Pecten (Hinnites) giganteus** *Gray.*

Hinnites giganteus GRAY, Ann. Phil., 1826, p. 103. CARPENTER, Brit. Assn. Rept., 1863, p. 675. GABB, Pal. Cal., Vol. II, 1869, p. 105. COOPER, 7th Ann. Rept. Cal. St. Min., 1888 p. 243. KEEP, West Coast Shells, p. 165, fig. 138, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 193. + *H. poulsoni* CONR. = (?) *H. crassus* CON., (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 711.)

Shell large, oval, irregular, inequivalve, subequilateral; surface sculptured by about seventeen irregular, squamose, rounded, prominent radiating ridges, with two or three minor ones between each pair of the large ones.

Dimensions.—Long. 65 mm.; alt. 65 mm.; diam. 25 mm.

Adults distinguishable from *Pecten* on account of distortion caused by attachment to some object during the later stages of growth. The young, unattached shells of this species much resemble the young of *P. hastatus*. but are distinguishable from this species by a less spinose growth on the ribs, and also in having a much heavier shell.

Rare in upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's, and Deadman Island; a few specimens from the lower San Pedro series of San Pedro.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—Santa Rosa Island; Ventura County; Los Angeles County (Cooper).

Family X. LIMIDÆ.

Genus **Lima** (*Bruguière*) *Cuvier.*

Shell equivalve, compressed, obliquely oval; anterior side straight, gaping, posterior rounded, usually close; umbones apart, eared; valves white, smooth, punctate-striate, or radiately ribbed and imbricated; there is usually a thin, brownish epidermis; hinge-area triangular, cartilage pit central; adductor impression lateral, large, double; pedal scars, two, small.

Lima squamosa Lam. is a characteristic species.

Subgenus **Lima** *s. s.*

Hinge edentulous; valves gaping, inequilateral.

Section *Mantellum Adams.*

Submargins not impressed.

Type, *Lima hians* Gmel.

37. Lima (Mantellum) dehiscens *Conrad*.

Lima dehiscens Con., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 247, Pl. XIX, fig. 7. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 245. Dall, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 769.

Lima orientalis (not of Ad. & Rve.) of Carpenter, Brit. Assn. Rept., 1863, p. 645. Keep, West Coast Shells, p. 168, fig. 142, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 193.

Shell equivalve, compressed, obliquely oval, thin, white; anterior side straight; posterior rounded; umbones eared, posterior ears acutely pointed; surface smooth, radiately striate with fine grooves; hinge-area long, narrow, triangular; cartilage pit central, prominent; margin finely crenulated.

Dimensions.—Long. 13 mm.; alt. 18.5 mm.; diam. 8 mm.

Looks like an obliquely deformed *Pecten*. Specimen identified by Dr. Dall.

Rare in lower San Pedro series of Deadman Island; one specimen collected by Mrs. Oldroyd.

Living.—Monterey to San Diego (Cooper); Santa Catalina Island (Arnold).

Pleistocene.—San Pedro (Mrs. Oldroyd).

Pliocene.—Santa Barbara (Cooper).

Superfamily ANOMIACEA.

Family XI. ANOMIIDÆ.

Genus Pododesmus *Philippi*.

Shell suborbicular, very variable, translucent and slightly pearly within; attached by a plug passing through a hole or notch in the right valve; a single conspicuous byssal scar on the disk; valves radiately grooved; hinge unarmed.

Pododesmus rudis Brod. is a characteristic species.

Section *Monia Gray*.

Adult hole or foramen large.

Pododesmus machroschisma Deshayes is a characteristic species.

38. Pododesmus (Monia) macroschisma *Deshayes*.

Anomia macroschisma Desh., Reeve, Zool. Soc. Cuvierienne, 1839, p. 359. Mag. Zool., 1841, Pl. XXXIV. Middendorf, Beitr. Mal. Ross., Bd. III, 1849, p. 6. Philippi, Abbild. beschr. Conch., 1850, p. 132, Pl. I, fig. 4.

Placunanomia macroschisma Desh., Gray, Proc. Zool. Soc., 1849, p. 121. Cat. Anam. Brit. Mus., 1850, p. 12. Carpenter, Brit. Assn. Rept., 1863, p. 646. Tryon, Syst. Conch., Vol. III, p. 294, Pl. CXXXI, fig. 76, 1884. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 260. Keep, West Coast Shells, 1892, p. 163, fig. 137.

Placunanomia (Monia) macroschisma Desh., Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 194.

Pododesmus (Monia) macroschisma Desh. = *Placunanomia cepio* Gray = *Placunanomia alope* Gray, (*fide* Dall, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 780).

"Shell adherent, subequivalve, irregular, flattened; hinge with two thick, divergent, elongated lamella in the inferior, corresponding with two long pits in the upper valve; upper valve with only two muscular impressions; the pedal scar radiately striated"; surface with incremental laminæ and sometimes radial ridges.

Part of the above description was taken from Tryon. This species resembles *Anomia lampe*, but may be distinguished by its greater size and fewer muscle-impressions. Specimen identified by Dr. Dall.

Rare in the upper San Pedro series of San Pedro, Crawfish George's, and Deadman Island. Found also in the Pleistocene of the bluff west of the bath-house, at Santa Barbara.

Living.—Unalaska to San Diego; Japan (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold): California; Oregon; Alaska (Dall): Santa Barbara (Arnold).

Pliocene.—San Diego well (Dall).

Miocene.—Sooke, Vancouver Island (Newcombe).

Genus **Anomia** *Linné*.

Shell suborbicular, translucent, attached by a plug passing through a hole or notch in the right valve; upper valve convex, smooth, lamellar, or striated; two byssal scars on the disk, main byssal scar largest; foramen open, ample; hinge unarmed.

Anomia ephippium Linné is a characteristic species.

39. **Anomia lampe** *Gray*.

Anomia lampe GRAY, Proc. Zool. Soc., 1849, p. 114. CARPENTER, Brit. Assn. Rept., 1863, p. 646. GABB, Pal. Cal., Vol. II, 1869, p. 106. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 229. KEEP, West Coast Shells, p. 163, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 194. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 785.

Shell of medium size, suborbicular, thin, translucent and slightly pearly within; surface of left valve sculptured with fine, irregular, concentric lamellar lines and several prominent, irregular, rounded, radiating ridges; interior of this valve with submarginal cartilage pit and four muscular impressions; right or lower valve concave, with a deep rounded notch in front of the cartilage process.

Dimensions.—Long. and alt. 48 mm.; diam. 9 mm.

This species is variable both in regard to its shape and its sculpture, but is easily distinguishable by the thin, lamellar, translucent shell. Distinguishable from *A. limatula* Dall by its smaller size and radial ridges. Specimens identified by Dr. Dall.

Common in the upper San Pedro series of San Pedro, Los Cerritos, Long Beach, and Crawfish George's; rare in the lower San Pedro series of Deadman Island

and San Pedro. Found also in the Pleistocene at Barlow's ranch, Ventura, and in the Pleistocene of Spanish Bight and Pacific Beach, San Diego.

Living.—Monterey to Mexico (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): Ventura; San Diego (Arnold).

[S. D.] **Anomia limatula** *Dall.*

Anomia limatula DALL., Proc. U. S. Nat. Mus., Vol. I, 1879, p. 15. Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 785, Pl. XXXV, fig. 19.

Shell large, thin, irregular, with a rather thickened hinge-line; external surface rough, like fresh fractured china-ware; surface devoid of all normal radial sculpture, and still retaining on its yellowish valves traces of dark purple, irregularly radial blotches. The calcareous plug of this species is peculiar, being hollow, and the cylinder incomplete on one side.

Distinguishable from *A. lampe* and *Pododesmus macroschisma* by its lack of radial sculpture. Reported in the Pleistocene of San Pedro by Stearns.

Pleistocene.—San Pedro (Stearns): Ventura County, eight miles inland and two hundred feet elevation above sea-level (Bowers): Spanish Bight and Coronado Beach, San Diego (Hemphill; Stearns): Twenty-sixth Street, San Diego (Hemphill; Arnold).

Superfamily MYTILACEA.

Family XII. MYTILIDÆ.

Genus **Mytilus** (*Linné*) *Bolten.*

Shell wedge-shaped, rounded behind; umbones terminal, pointed; hinge-teeth minute or obsolete; pedal muscular impressions two in each valve, small, simple, close to the adductors.

Mytilus smaragdinus Chemn. is a characteristic species.

Section *Mytilus s. s.*

Surface with chiefly concentric sculpture, or smooth.

Type, *Mytilus edulis* Linné.

40. **Mytilus edulis** *Linné.*

Mytilus edulis LINN., Syst. Nat., Ed. X, 1758, p. 705. = *M. borealis* LAM. = *M. abbreviatus* LAM. = *M. vetustus* LAM. = *M. incurvatus* LAM. = *M. pellucidus* PENNANT = *M. notatus* DEKAY = *M. subsaxatilis* WILLIAMSON (*fide* CARPENTER, Brit. Assn. Rept., 1856, p. 219). CARPENTER, Brit. Assn. Rept., 1863, p. 643. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 252. KEEP, West Coast Shells, p. 173, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 191. = *Modiola pulex* H. C. LEA (not of LAM.) = *Mytilus minganensis* MIGHELS, &c. (*fide* DALL, Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 788).

Mytilus pedroanus CON., Pac. R. R. Rept., Vol. V, 1853, p. 325, Pl. V, fig. 40.

Shell of medium size, wedge-shaped, rounded behind, thin; surface smooth, except for concentric, incremental lines; umbones terminal; dorsal margin slightly depressed in middle; hinge-teeth minute.

Dimensions.—Long. 55 mm.; lat. 24 mm.; diam. 18 mm.

The only difference between the Pleistocene specimens and the living form is in the coloration of the epidermis, that of the former being reddish brown, while the latter is blue. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island; and in the upper San Pedro series of Deadman Island, Crawfish George's, and San Pedro.

Living.—San Pedro (Williamson): Monterey, north; Japan; circumpolar (Cooper): Atlantic Ocean south to North Carolina (Dall).

Pleistocene.—Benicia, Solano County (Cooper): San Pedro (Arnold): Atlantic coast from Labrador to St. John's River, Florida; northern Europe; northwest coast of America (Dall).

Pliocene.—Red Crag, Great Britain (Dall).

Genus **Septifer** *Recluz.*

Shell equivalve, very inequilateral; ventral margin subconcave and cut out for the passage of the byssus; beaks subterminal, curved; hinge without teeth, furnished with a lamellar septum; ligamental pits linear, marginal, dorsal, anterior, with a white, nearly spongy margin within; muscular impressions superficial, the anterior small, rounded, the posterior large, subdorsal, uniform.

Septifer heberti Desh. is a characteristic species.

41. **Septifer bifurcatus** *Conrad.*

Mytilus bifurcatus CONRAD, Journ. Phil. Acad. Sci., Vol. VII, 1837, p. 241, Pl. XVIII, fig. 14. REEVE, Conch. Icon., Pl. IX, fig. 41.

Septifer bifurcatus RVE., CARPENTER, Brit. Ass'n. Rept., 1863, p. 643. GABB, Pal. Cal., Vol. II, 1869, p. 101. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. KEEP, West Coast Shells, p. 171, fig. 144, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 191. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 789.

Shell small, wedge-shaped, equivalve, convex, rather thick; beaks pointed, terminal; surface sculptured by numerous strong, rounded, terminally bifurcating, radiating ridges, and fine concentric, incremental sulcations; margin corrugated; a small lamellar deck stretches across the interior of the shell near the umbo; teeth small.

Dimensions.—Beak to ventral margin 10 mm.; lat. 6 mm.; diam. 4 mm.

This little shell is shaped like a *Mytilus edulis*, but is smaller and has prominent, bifurcating, radiating ridges, delicate incremental sculpture, and an umbonal deck.

Rare in the lower San Pedro series at Deadman Island.

Living.—Farallon Islands to San Diego (Cooper).

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro (Arnold).

Genus **Modiolus** *Lamarck*.

Shell oblong, inflated in front; umbones anterior obtuse; hinge toothless; pedal impressions three in each valve, the central elongated; epidermis often produced into long beard-like fringes.

Type, *Mytilus modiolus* Linné.

Section *Modiolus s. s.*

Surface smooth, shell inflated, edentulous, epidermis more or less hirsute.

Type, *Mytilus modiolus* Linné.

42. **Modiolus fornicatus** *Carpenter*.

Modiola fornicata Cpr., Brit. Assn. Rep., 1863, p. 643; Ann. & Mag. Nat. Hist, 3rd Ser., Vol. XV, 1865, p. 179. Keep, West Coast Shells, p. 173, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 191.

Shell of medium size, short, oblong, inflated in front, swollen, equivalve; beaks anterior, not quite terminal, obtuse, marginal, bent forward; surface sculptured only with concentric incremental lines; margins smooth; no hinge teeth.

Dimensions.—Beaks to ventral margin 54 mm.; lat. 31 mm.; diam. 30 mm.

This species is distinguishable by its short, swollen form.

Rare in the lower San Pedro series of Deadman Island, and in the upper San Pedro series of Los Cerritos. Found also in the Pleistocene of Barlow's ranch, Ventura, and bluff west of bath-house, Santa Barbara.

Living.—Monterey to Santa Barbara (Carpenter): San Pedro (Williamson).

Pleistocene.—San Pedro (Arnold): Ventura; Santa Barbara (Arnold).

43. **Modiolus rectus** *Conrad*.

Modiola recta Con., Journ. Acad. Nat. Sci. Phil., Vol. VII, 1837, p. 243, pl. XIX, fig. 1. Carpenter, Brit. Assn. Rept., 1863, p. 643. Gabb, Pal. Cal. Vol. II, p. 101, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 251. Keep, West Coast Shells, p. 171, fig. 145, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192. Dall, Trans. Wagner Inst. Sci., Vol. III, Part. 4, 1898, p. 793.

Shell large, rhomboidal, narrow, evenly convex, not sharply ridged, sculptured by numerous fine, concentric, incremental lines; lower margin a nearly straight line; ligament long, narrow, straight.

Dimensions.—Long. 150 mm.; alt. 50 mm.; diam. 38 mm.

Specimen identified by Dr. Dall.

Rare in lower San Pedro series of Deadman Island, and the upper San Pedro series of Deadman Island, San Pedro, and Los Cerritos. Found also in the Pliocene of Pacific Beach, and the Pleistocene of Pacific Beach and Twenty-sixth Street, San Diego.

Living.—Santa Cruz to San Diego (Cooper).

Pleistocene.—San Pedro (Cooper, Arnold): San Diego (Arnold).

Pliocene.—Santa Rosa; Twelve Mile House, San Mateo County; Soquel, Santa Cruz County; San Fernando; San Diego well (Cooper): San Diego (Arnold).

Miocene.—El Toro Ranch, Monterey County; Foxin's, Santa Barbara County (Cooper).

Genus **Lithophaga** *Bolten.*

Shell cylindrical, inflated in front, wedge-shaped behind; epidermis thick and dark; interior nacreous.

Type, *Mytilus lithophagus* Linné.

44. **Lithophaga plumula** *Hanley.*

Lithophagus plumula HANLEY, CARPENTER, Brit. Assn. Rept., 1863, p. 644. KEEP, West Coast Shells, p. 171, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 192.
Lithophaga plumula HANLEY, DALL, Trans. Wagner Inst. Sci., Vol. III, Part. 4, 1898, p. 799.

Shell subcylindric, with nearly terminal beaks; two radial sulci extending backward from the beaks, incrustation plume-like, arranged in a distinct pattern on the areas between the sulci, and, when projecting beyond the ends of the valve, apposited symmetrically.

One perfect cast of a shell of this species was found on the inside of a *Metis alta* in the upper San Pedro series at Los Cerritos.

Living.—Monterey to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

Order ANOMALODESMACEA.

Superfamily ANATINACEA.

Family XIII. PERIPLOMIDÆ.

Genus **Periploma** *Schumacher.*

Shell oval, very inequivalve, inequilateral, slightly nacreous; left valve deepest; posterior side very short and contracted; hinge with a narrow, oblique, spoon-shaped process in each valve, and a small triangular ossicle; an internal rib proceeds from under the hinge to the posterior margin; muscular impressions unequal, the anterior long and narrow, the posterior small, semilunar; pallial impression marginal.

Periploma inæquivalvis Schum. is a characteristic species.

45. **Periploma argentaria** *Conrad.*

Periploma argentaria CON., Journ. Phil. Acad. Sci., Vol. VII, 1837, p. 238, Pl. XVIII, fig. 8. CARPENTER, Proc. Zool. Soc., 1856, p. 211; Brit. Assn. Rept., 1863. p. 638. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 258. KEEP, West Coast Shells, p. 204, fig. 175, 1892. DALL, mss., 1900.

Periploma planiuscula Sby. + *P. lenticularis* Sby. = *P. argentaria* Con. = *P. alta* C. B. Ad = *P. excurva* Cpr. (*fide* Stearns, Proc. U. S. Nat. Mus., Vol. XIII, 1890, p. 223). Dall, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 184.

Shell of medium size, elliptical, inequilateral, inequivalve, fragile; umbones small, anterior to center; posterior extremity long and evenly rounded, but produced farthest a little above the middle; anterior portion much shorter than posterior, faintly biangulated; surface sculptured by fine concentric, incremental lines; hinge a hollow spoon-shaped process, projecting inwards from below the umbones; this cartilage process is strengthened by an elongated callus slanting anteriorly; pallial sinus short, cuneiform.

Dimensions.—Long. 46 mm.; alt. 33 mm.; diam. 18 mm.; umbo to anterior extremity 13 mm.; to posterior extremity 33 mm.

Specimens identified by Dr. Dall.

Rare in the San Pedro series of San Pedro, Los Cerritos, Crawfish George's, and Deadman Island. Found also in the Pleistocene at Twenty-sixth Street and Spanish Bight, San Diego.

Living.—Point Conception south to Mexican coast (Stearns).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper, Arnold.)

Family XIV. THRACIIDÆ.

Genus **Thracia** *(Leach) Blainville.*

Shell oblong, nearly equivalve, slightly compressed, attenuated and gaping posteriorly; smooth or minutely scabrous; cartilage process thick, not prominent, with a crescentic ossicle; pallial sinus shallow.

Thracia pubescens Pult. is a characteristic species.

46. **Thracia trapezoides** *Conrad.*

Thracia trapezoides Con., Wilkes Exped., Vol. X, 1849, p. 723, Pl. XVII, fig. 6. Gabb, Pal. Cal., Vol. II, 1869, p. 90. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 267.

Shell of medium size, subtrigonal, compressed, thin; umbones central, bent slightly posteriorly; anterior margin evenly arcuate from umbones, bending off quite evenly into the arcuate ventral margin; anterior extremity most produced near base; posterior dorsal margin depressed near umbo, sloping off slightly concavely to a line which abruptly truncates the posterior extremity; this truncating line is slightly arcuate, but is angular at both ends; surface sculptured by faint incremental lines; a prominent fold runs from the umbones to the lower part of the truncated extremity.

Dimensions.—Long. 48 mm.; alt. 38 mm.; diam. 16 mm.

After comparing the San Pedro Pliocene specimens with several Miocene shells from the Astoria horizon of Blakely, Washington (Conrad's type came from this same horizon), it is evident that the two forms are identical. The San Pedro specimens, however, average much larger in size. Dr. Dall labeled these specimens "*Thracia? curta.*" *T. curta* is much less depressed behind the beaks, has a much straighter ventral margin, and a more evenly rounded anterior extremity than *T. trapezoides*.

This species is found in only one narrow stratum of the San Pedro Pliocene. This stratum outcrops near the base of Deadman Island, and also on the top of the ridge at the head of the railroad grade in the southeastern part of San Pedro. It is the predominating species in this one stratum.

Pliocene.—Eagle Prairie, Humboldt County (Cooper): San Pedro (Arnold).

Miocene.—Oregon (Cooper): Blakely, near Seattle, Washington (Arnold).

Family XV. PANDORIDÆ.

Genus **Pandora**.

Shell inequivalve, thin, pearly inside; valves close, attenuated behind; right valve flat, with a diverging ridge and cartilage furrows; left valve convex, with two diverging grooves at the hinge; pallial line slightly sinuated.

Subgenus **Kennerlia** *Carpenter*.

Hinge ossicle thin; radiating ribs on the right valve.

Type, *Kennerlia bicarinata* Carpenter.

47. **Pandora (Kennerlia) bicarinata** *Carpenter*.

PLATE XVIII, FIG. 2.

Kennerlia bicarinata CPR., Brit. Assn. Rept., 1863, p. 638; Proc. Zool. Soc., 1864, p. 603. TRYON, Syst. Conch., Vol. III, 1884, p. 143.

? *Pandora bilirata* CON., COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 257.

Shell small, planoconvex, oval, thin; umbones minute, about one-third length from anterior end; anterior and posterior dorsal margins straight, making an angle a little less than 160 degrees at the umbo; ventral margin arcuate, rounding upward at each end and meeting dorsal margins in angulated turns; two posterior submarginal ridges run from the umbo to the extremity in the convex valve; surface sculpture and hinge as in *K. filosa*.

Dimensions.—Long. 14 mm.; alt. 9 mm.; diam. 3 mm.; umbones to anterior extremity 4 mm.; to posterior extremity 10 mm.

This species is closely related to *K. filosa*, but is distinguishable by its broader, shorter shell, rounded rather than beaked posterior extremity, and more nearly central umbones. Probably the same as *Pandora bilirata* of Conrad.

One left valve from the lower San Pedro series of Deadman Island, which is figured, and is now in the possession of Delos Arnold.

Living.—Catalina Island (Carpenter).

Pleistocene.—San Pedro (Arnold): Santa Barbara (Cooper).

48. Pandora (Kennerlia) filosa *Carpenter.*

PLATE XVIII, FIG. 3.

Kennerlia filosa CPR., Brit. Assn. Rept., 1863, p. 638; Proc. Zool. Soc., 1864, p. 602.

Shell small, planoconvex, elongate-oval, thin; umbones minute, about one-fourth length from anterior extremity; anterior and posterior dorsal margins straight, making an angle of 160 degrees at the umbo; ventral margin arcuate; posterior extremity long, narrowed and truncated at the end; anterior rounded up from base but making an angle with dorsal margin; a single prominent posterior, submarginal ridge runs from umbo to extremity on each valve, being nearer the margin in the flat valve; surface of both valves sculptured by numerous fine, concentric, incremental lines, and that of the right valve by fine radiating sulcations; left valve with a thin hinge ossicle; right valve with two ossicles, the anterior one being short.

Dimensions.—Long. 16 mm.; alt. 7 mm.; diam. 3 mm.; umbo to anterior end 4 mm.; to posterior end 12 mm.

The right valve of this little shell looks something like a wing, and resembles *Clidiophora punctata*, but is distinguishable by the straight dorsal margin, radiating sulcations, and narrower form.

Specimens identified by Dr. Dall.

One right and one left valve found in the lower San Pedro series of Deadman Island. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound (Carpenter).

Pleistocene.—San Pedro (Arnold).

Genus Clidiophora *Carpenter.*

Shell inequivalve, thin, pearly inside; valves close, attenuate behind; right valve rather tumid, with three hinge teeth, the posterior one elongated; left valve often with two teeth; ossicle present; pallial line simple.

Clidiophora claviculata Carp. is a characteristic species.

49. Clidiophora punctata *Conrad.*

Pandora punctata CON., Journ. Phil. Acad. Sci., Vol. VII, 1837, p. 228, Pl. XVII, fig. 1.

Clidiophora punctata CON., CPR., Brit. Assn. Rept., 1863, p. 638. CPR., Proc. Zool. Soc., 1864, p. 598. GABB, Pal. Cal., Vol. II, p. 90, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 235. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 183.

Shell rather small, suboval, much compressed, thin; umbo posterior to center, marginal, not elevated; anterior dorsal margin concavely arcuate; anterior extremity rostrated; posterior extremity evenly rounded; outer surface sculptured with fine, concentric, incremental lines; interior pearly, punctate; right valve slightly tumid, with three hinge teeth; left valve with two hinge teeth.

Dimensions.—Long. 30 mm.; alt. 19.5 mm.; diam. 5 mm.; umbo to anterior end 21 mm.; to posterior end 9 mm.

Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island and upper San Pedro series of San Pedro. Found also at Spanish Bight, San Diego.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Arnold).

Pliocene.—San Benito County (Cooper).

Miocene.—Ventura County (Cooper).

Family XVI. LYONSIIDÆ.

Genus **Lyonsia** *Turton.*

Shell nearly equivalve, left valve largest; thin, subnacreous, close, truncated posteriorly; cartilage plates oblique, covered by an oblong ossicle; pallial sinus obscure, angular.

Lyonsia norvegica is a characteristic species.

50. **Lyonsia californica** *Conrad.*

Lyonsia californica CON., Journ. Phil. Acad. Sci., Vol. VII, 1837, p. 248, Pl. XIX, fig. 20. CPR., Proc. Zool. Soc., 1856, p. 210; =*L. bracteata* GLD. =*L. nitida* GLD., (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 638). KEEP, West Coast Shells, p. 202, fig. 174, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 184.

Shell of medium size, elongate-oval, truncated and narrowing slightly posteriorly, convex, thin; long, slightly depressed posterior to umbo; short, convex anterior; surface sculptured with fine, concentric, incremental lines; external layer chalky and fugacious, pearly beneath; cartilage-plates oblique, covered by an oblong ossicle; pallial sinus obscure.

Dimensions.—Long. 31 mm.; alt. 14 mm.; diam. 11 mm.

This frail shell is generally found with the outer layer gone, leaving the pearly surface of the lower layer exposed. Outline variable.

Specimens identified by Dr. Dall.

Rather common in the Pliocene of Deadman Island, the lower San Pedro series of Deadman Island and San Pedro, and the upper San Pedro series of Deadman Island, Crawfish George's, and San Pedro.

Living.—Puget Sound to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Mytilimeria** *Conrad.*

Shell rounded oval, more or less ventricose, equivalve, fragile, covered by a thin caducous epidermis; beaks subspiral; hinge without teeth, but formed of small linear excavations under the beaks to receive the ligament, which contains a small ossicle; muscular impressions small; pallial impression with an obtuse sinus.

Type, *Mytilimeria nuttalli* Conrad.

51. **Mytilimeria nuttalli** *Conrad.*

Plate XVII, Fig. 8.

Mytilimeria nuttalli Con., Journ. Phil. Acad. Sci., Vol. VII, 1837, p. 247. Cpr., Brit. Assn. Rept., 1863, p. 638. Gabb, Pal. Cal., Vol. II, p. 90, 1869. Tryon, Syst. Conch., Vol. III, 1884, p. 147, Pl. CVIII, fig. 68. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 252. Keep, West Coast Shells, p. 203, 1892.

Shell small, equivalve, suboval, convex, thin; beaks central, subspiral, small; surface sculptured by fine, concentric, incremental lines and numerous delicate radiating sulcations, the whole having a pearly luster; hinge edentulous, with a slight linear cavity under the beaks; pallial sinus broad, obtuse.

Dimensions.—Long. 11 mm.; alt. 17 mm.; diam. 10 mm.

This fragile little shell resembles a very small and broad *Mytilus*, but is easily distinguishable by its delicate sculpture. Specimens identified by Dr. Dall.

Rare in the Pliocene and lower San Pedro series of Deadman Island, and in the lower San Pedro series of San Pedro.

The species figured is imperfect. It came from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold).

Miocene.—Tomales, Marin County (Cooper).

Superfamily POROMYACEA.

Family XVII. VERTICORDIIDÆ.

Genus **Verticordia** *S. Wood.*

Shell suborbicular, with radiating ribs; beaks subspiral; margins denticulated; interior brilliantly pearly; hinge with one prominent cardinal tooth in each valve; adductor scars two, faint; pallial line simple; ligament internal, oblique; epidermis dark brown.

Type, *Verticordia cardiiformis* Wood.

52. **Verticordia novemcostata** *Adams & Reeve.*

Plate XVII, Fig. 10.

Verticordia novemcostata Ad. & Rve. = *V. ornata* D'Orb. (*fide* Cpr., Brit. Assn. Rept., 1863, p. 645.)

Shell small, suborbicular, compressed, thin; beaks subcentral, subspiral, small, sharp, anterior extremity evenly rounded; posterior dorsal margin evenly arcuate, and joining arcuate ventral margin in an angular extremity; surface with nine prominent, sharp, arcuate, radiating ridges; the first and third interspaces wider than the others; margins sharply denticulate; hinge with one prominent cardinal tooth in each valve; adductor scars two, faint; pallial line simple; ligament internal, oblique; interior pearly.

Dimensions.—Long. 4 mm.; alt. 3.5 mm.; diam. 2 mm.

This little shell is one of the unique species of this fauna. Specimens identified by Dr. Dall.

One specimen from lower San Pedro series of Deadman Island, which is figured, and is now in the collection of Delos Arnold.

Living.—Santa Barbara; Samarang, China; South America (Carpenter): San Pedro (Raymond).

Pleistocene.—San Pedro (Arnold).

Order TELEODESMACEA.

Superfamily ASTARTACEA.

Family XVIII. ASTARTIDÆ.

Genus **Astarte** *Sowerby*.

Shell suborbicular, compressed, thick, smooth, or concentrically furrowed; lunule compressed; ligament external; epidermis dark; hinge-teeth two in each valve, the anterior tooth of the right valve large and thick; anterior pedal scar distinct; pallial line simple.

Astarte semisulcata Leach is a characteristic species.

Subgenus **Crassinella** *Bayle*.

Shell obliquely lengthened, subquadrangular.

Astarte obliqua Desh. is a characteristic species.

53. **Astarte (Crassinella) branneri**, sp. nov.

PLATE XVIII, FIG. 12.

Shell small, subtrigonal, equivalve, inequilateral, convex, thick; umbo small, sharp; anterior dorsal margin straight to anterior extremity, where it meets the arcuate ventral margin in an angle; posterior dorsal margin evenly arcuate, sloping down to rounded, posterior extremity; surface sculptured with numerous angular, concentric undulations or ridges; lunule long, narrow, extending to anterior extremity, and circumscribed by a narrow, angular ridge; ligament external, not prominent; two prominent cardinal teeth in right valve; one in left; no laterals; pallial line entire, running from the middle of adductor scars; adductor scars subequal, small.

Dimensions.—Long. 10 mm.; alt. 8.9 mm.; diam. 5 mm.

This species somewhat resembles *Astarte compacta* Cpr., but has a longer lunule, finer concentric ridges, and is more bilaterally symmetrical. Specimens pronounced a new species by Dr. Dall. Named in honor of Dr. John C. Branner, Professor of Geology, Leland Stanford Junior University.

Rare in the upper San Pedro series of San Pedro and Los Cerritos. The specimen figured is the type, which is from the upper San Pedro series at Los

Cerritos, and is now in the United States National Museum. Found also in the Pleistocene of Twenty-sixth Street, San Diego.

Pleistocene.—San Pedro; San Diego (Arnold).

Superfamily CARDITACEA.

Family XIX. CARDITIDÆ.

Genus **Venericardia** *Lamarck.*

Shell suborbicular, inequilateral, radiately ribbed; hinge with two oblique cardinal teeth and no laterals.

Venericardia planicostata Lamarck is a characteristic species.

54. **Venericardia barbarensis** *Stearns.*

Venericardia barbarensis STEARNS, Proc. U. S. Nat. Mus., Vol. XIII, 1891, p. 214, Pl XVI, figs. 3, 4.

Shell rounded, inequilateral, variable in outline, more or less oblique, moderately convex; beaks small, slightly elevated and turned forward; surface ornamented with nineteen or twenty radiating ribs, usually somewhat granulose; lunule small, slightly sunken, faintly defined; hinge-line small, not thick; hinge composed of, in left valve, a single strong cardinal sloping posteriorly and a smaller tooth, often obscure, slanting anteriorly; a third tooth-like process is generally present, situated under, and apparently a projection of, the edge of the lunule; the right valve has a single strong cardinal tooth with a slanting, somewhat sinuous groove above and a slight notch and tooth-like point below the upper part of the lunule; muscle impressions small.

Dimensions.—Long. 19.5 mm.; alt. 17 mm.; diam. 14 mm.

Distinguishable from *V. ventricosa* by more subrectangular outline, greater relative length; greater number of ribs, less prominent beak, much narrower and longer hinge-line, and shorter, slighter posterior cardinal tooth, which is straight.

Common in Pliocene and lower San Pedro series of Deadman Island; rare in Pliocene at Timm's Point and upper San Pedro series of Crawfish George's and San Pedro. Found also west of bath-house at Santa Barbara.

Living.—Santa Barbara Islands (276 fathoms) (Stearns).

Pleistocene.—San Pedro (Arnold); Santa Barbara (Arnold).

Pliocene.—San Pedro (Arnold).

55. **Venericardia ventricosa** *Gould.*

Cardita ventricosa GLD., Proc. Bost. Soc. Nat. Hist., 1850, p. 276; Wilkes Expl. Exped., Vol. XII, p. 417, Pl. XXXVI, fig. 532, 1852, = *C. subtenta* CON., = *C. monilicosta* GABB, = *C. occidentalis* CON., (*fide* GABB, Pal. Cal., Vol. II, 1869, p. 100).

Venericardia borealis var. *ventricosa* GLD., CPR., Brit. Assn. Rept., 1863, p. 643. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 269.

Venericardia ventricosa GLD., STEARNS, Proc. U. S. Nat. Mus., Vol. XIII, 1891, p. 216, Pl. XVI, figs. 5 and 6. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190.

Shell small, subcircular, ventricose, thick; umbones slightly anterior to center, much bent forward, prominent; surface sculptured by about thirteen prominent, rounded, radiating ridges, which are slightly roughened by regular lines of growth; sulcations narrow; hinge area broad, short; two prominent teeth in each valve, anterior short; margin closely crenulated.

Dimensions.—Long. 12.5 mm.; alt. 13 mm.; diam. 8 mm.

Distinguishable by small size, coarse sculpture and heavy hinge. Common in the Pliocene of Deadman Island and Timm's Point; rare in lower San Pedro series of Deadman Island. Found also in Pleistocene of Pacific Beach, near San Diego; and in the Pliocene of Packard's Hill and the Pleistocene near the bath-house, Santa Barbara.

Living.—Alaska to Catalina Island (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara; San Diego (Arnold).

Pliocene.—San Fernando; Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara (Arnold).

Miocene.—Oregon; Foxin's, Santa Barbara County; Santa Monica (Cooper): Blakeley, near Seattle, Washington (Arnold).

Genus **Lazaria** *Conrad.*

Shell transverse, oblong, inequilateral; beaks subanterior, radiately ribbed; hinge with two cardinal and two lateral diverging teeth in each valve, the posterior teeth being in each case much elongated, the anterior short and more or less pointed, sublunular.

Lazaria pectunculus Brug. is a characteristic species.

56. **Lazaria subquadrata** *Carpenter.*

Lazaria subquadrata CPR., Brit. Assn. Rept., 1863, p. 642; Ann. Mag. Nat. Hist., 3d ser., Vol. XV, 1865, p. 179. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244. KEEP, West Coast Shells, p. 179, fig. 152, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190.

Shell small, transverse, subrectangular, inequilateral, ventricose, thick; beaks subanterior, not prominent; dorsal posterior margin long, straight; anterior portion abruptly truncated just in front of beak; surface sculptured with heavy, squamose, rounded, radiating ridges; interior margin coarsely crenulated; hinge with two lateral diverging teeth in each valve, the posterior teeth being in each case much elongated, the anterior short and pointed.

Dimensions.—Long. 10 mm.; alt. 6 mm.; diam. 5 6 mm.

Distinguishable by its small size, rectangular outline, and coarse, squamose ridges which radiate from one corner of the rectangle. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of Crawfish George's and San Pedro.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Superfamily CHAMACEA.

Family XX. CHAMIDÆ.

Genus **Chama** (*Pliny*) *Linné*.

Shell attached usually by the left umbo; valves foliaceous; the upper smallest; hinge-tooth of free valve thick, curved, received between two teeth in the other; adductor impressions large; oblong, the anterior encroaching on the hinge-tooth.

Chama lazarus Linné is a characteristic species.

57. **Chama exogyra** *Conrad*.

Chama exogyra Con., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 256. Reeve, Conch. Icon., sp. 38, Pl. VII. Carpenter, Proc. Zool. Soc., 1856, p. 217; Brit. Assn. Rept., 1863, p. 641. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 233; Bull. Cal. St. Min. Bureau, No. 4, 1894, p. 24. Keep, West Coast Shells, p. 182, 1892. Williamson, U. S. Nat. Mus., Vol. XV, 1892, p. 189.

Shell of medium size, oval, irregular; left valve subcompressed, thick, attached when living; umbo small, submarginal, much twisted, either dextral or sinistral, generally the former; surface foliated with irregular, disconnected, rough, translucent, concentric frills; hinge-tooth thick in free valve; two teeth in attached valve; adductor impressions large, oblong, the anterior encroaching on the hinge-tooth.

Dimensions.—Long. 33 mm.; alt. 33 mm.; diam. 16 mm.

Distinguishable from *C. pellucida* by larger, thicker shell, fewer and less spiny, though more prominent frills; and by being attached generally by the left valve. Specimens identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro and Los Cerritos.

Living.—Bodega Bay to San Diego; Mexico (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Pedro (Arnold): San Nicolas Island (Bowers).

58. **Chama pellucida** *Sowerby*.

Chama spinosa Brod. var. *pellucida* Sby., Proc. Zool. Soc., 1834, p. 150.

Chama pellucida Sby., Cpr., Brit. Assn. Rept., 1863, p. 641. Keep, West Coast Shells, p. 182, fig. 155, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 189. Cooper, Bull. Cal. St. Min. Bureau, No. 4, 1894, p. 24.

Shell of medium size; right valve (attached), exceedingly ventricose, rather thin; left valve nearly flat, thicker; surface of attached valve sculptured with numerous prominent, spiny frills; surface of upper valve with more numerous, small frills, which are sometimes spiny near the margin of the valve; hinge-teeth and muscle-impressions as in *C. exogyra.*

Dimensions.—Long. 20 mm.; alt. 25 mm.; diam. 15 mm.

Distinguishable from *C. exogyra* by smaller size, more prominent frills on upper valve, and by the fact that in *C. pellucida* the right valve is generally attached, and is exceedingly ventricose, while in *C. exogyra* the left valve is the larger, and is attached. Specimens identified by Dr. Dall.

Rather common in the Pliocene; rarer in the lower San Pedro series of Deadman island; and only found occasionally in the upper San Pedro series of San Pedro, Deadman Island, Los Cerritos, and Crawfish George's.

Living.—San Francisco to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

Pliocene.—Ventura County (Bowers).

Superfamily LUCINACEA.

Family XXI. LUCINIDÆ.

Genus **Lucina** *Bruguière.*

Shell orbicular, white; umbones depressed; lunule distinct; margins smooth or minutely crenulated; ligament oblique, semi-internal; hinge-teeth two in each valve; laterals, two in right valve, four in left; muscular impressions rugose; anterior elongated within the pallial line, posterior oblong; umbonal area with an oblique furrow.

Lucina jamaicensis Linné is a characteristic species.

59. **Lucina acutilineata** *Conrad.*

Lucina acutilineata CON., Wilkes Expl. Exped., Vol. X, p. 725, Pl. XVIII, fig. 2, 1849.
Cyclas acutilineata CON., Jour. Conch., 1865, p. 153.
Lucina borealis (not of LINNÆUS, Syst. Nat., Edition XII, p. 1413); of CPR., Brit. Assn. Rept., 1863, p. 643; =*Pectunculus patulus* CON., Jour. Conch., 1865, p. 153; not Wilkes Expl. Exped., p. 726. Pl. XVIII, fig. 9; =*Lucina tetrica* CON. (*fide* GABB, Pal. Cal., Vol. II, p. 100, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 246.

Shell large, orbicular, only slightly convex, rather thin; umbones depressed, central; surface ornamented by numerous equal, equidistant, sharp, raised, concentric lines; interspaces show lines of growth; lunule small, but deeply impressed and distinct; two sharp cardinal teeth in each valve; lateral teeth nearly obsolete; anterior muscle-impression much elongated.

Dimensions.—Long. 57 mm.; alt. 53 mm.; diam. 28 mm.

This species is easily distinguishable by its large size and sharp, concentric, raised lines. This beautiful shell is always found in a fine state of preservation in the Deadman Island formations, in many cases occurring in pairs. The shell is translucent, and in only a few instances have imperfect specimens been found. The convexity of the shell is slightly variable, being more in the younger shells, the older ones being inclined to become flatter. The Pliocene specimens are smaller, more convex, and have the concentric lines much closer set than do the Pleistocene forms. Specimens identified by Dr. Dall.

Common in Pliocene and lower San Pedro series of Deadman Island and San Pedro; rare in the upper San Pedro series of Deadman Island, Crawfish George's, and San Pedro. Only one or two specimens have been found in each of the upper San Pedro localities; thus practically restricting the northern species to the Pliocene and lower San Pedro series. Found also in the Pleistocene west of bath-house, Santa Barbara; and in the Pleistocene of Pacific Beach, San Diego.

Living.—Catalina Island (Cooper): Santa Barbara channel (Carpenter): Puget Sound (Arnold).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara; San Diego (Arnold).

Pliocene.—Santa Rosa; Santa Cruz; Sargent's, Santa Clara County; Santa Barbara; San Fernando; San Diego well (Cooper): Stanford University (Arnold).

Miocene.—Oregon; Martinez; Griswold's, San Benito County; Orestima Canyon, Stanislaus County; Foxin's, Santa Barbara County (Cooper): Point Blakely, near Seattle, Washington (Arnold).

60. Lucina californica *Conrad.*

Lucina californica CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 255, Pl. XX, fig. 1. CPR., Brit. Assn. Rept., 1863, p. 642. GABB, Pal. Cal., Vol. II, 1869, p. 100. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 247. KEEP, West Coast Shells, p. 178, fig. 151, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190.

Shell of medium size, orbicular, only slightly convex, rather thick; umbones depressed, central; surface ornamented with numerous fine, close-set, sharp, concentric lines and very faint, fine, radiating striæ; lunule small but distinct, deep-set, wholly in right valve; ligament prominent; two cardinal teeth in each valve; two prominent anterior, lateral teeth in left valve, one in right valve, other laterals small; muscle-impressions as in *L. acutilineata.*

Dimensions.—Long. 31 mm.; alt. 29 mm.; diam. 16 mm.

Distinguishable from *L. acutilineata* by smaller size, close-set, concentric lines, and having the lunule wholly within the right valve.

Found in the Pliocene of Deadman Island; in the lower San Pedro series of Deadman Island and San Pedro; and rarely in the upper San Pedro series at Crawfish George's, San Pedro, Los Cerritos, Deadman Island, and Long Beach. Found also in the Pleistocene at the bath-house, Santa Barbara, and in the Pleistocene of Pacific Beach, San Diego.

Living.—Santa Cruz to San Diego (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro; Santa Barbara; San Diego (Arnold).

61. Lucina nuttalli *Conrad.*

Lucina nuttalli CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 255, fig. 2, Pl. XX. CPR., Brit. Assn. Rept., 1863, p. 642. GABB, Pal. Cal., Vol. II, p. 100, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 247. KEEP, West Coast Shells, p. 179, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190.

Shell small, orbicular, only slightly convex, thin; umbones depressed, small, central; surface ornamented by numerous sharp, regular, concentric lines and prominent radiating grooves, which are most prominent near the ends, the whole giving a rather cancellated appearance to the surface; lunule small, nearly all in left valve; hinge and interior as in *L. californica.*

Dimensions.—Long. 20 mm.; alt. 20 mm.; diam. 10 mm.

Distinguishable by small size, cancellated surface, and lunule in left valve. Specimens identified by Dr. Dall.

Common in the lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's, Deadman Island, and Long Beach. Found also in the Pliocene of Pacific Beach, and the Pleistocene of Twenty-sixth Street and Pacific Beach, San Diego.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Diego (Arnold).

62. **Lucina tenuisculpta** *Carpenter.*

Lucina tenuisculpta Cpr., Brit. Assn. Rept., 1863, p. 642. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 247.

Shell small, orbicular, deeply convex, thin; umbones prominent, central; surface sculptured by numerous fine, concentric lines and radiating striæ; lunule prominent, the greater part being in the right valve; cardinal teeth small, laterals prominent; anterior muscle-impressions not as elongated as in *L. acutilineata* and others.

Dimensions.—Long. 9 mm.; alt. 8.8 mm.; diam. 6.4 mm.

Distinguishable by small size, sculptured surface, and great convexity. This species resembles *Diplodonta orbella* very closely in shape and size, but may be distinguished by the lack of prominent cardinal teeth, by its lateral teeth, and by the radiating striæ. Specimens identified by Dr. Dall.

Rare in the upper San Pedro series of San Pedro. Found also in the Pleistocene of Spanish Bight, San Diego.

Living.—Straits of Fuca to Catalina Island; Mazatlan (Cooper).

Pleistocene.—San Pedro; San Diego (Arnold).

Pliocene.—San Diego well (Dall).

Family XXII. DIPLODONTIDÆ.

Genus **Diplodonta** *Brown.*

Section *Diplodonta s. s.*

Shell rotund, equilateral, externally concentrically striated or smooth, with inconspicuous epidermis; two cardinal teeth in each valve, of which the right posterior and the left anterior are distally sulcate or bifid; no lateral teeth; the hinge-plate when developed is usually excavated distally; there is no circumscribed lunule or escutcheon; the adductor scars are subequal, continuous with the pallial line, and close to the hinge-plate; the margin is entire, the pallial line simple, and pallial area often radiately striate.

Type, *Diplodonta lupinus* Brocchi.

63. **Diplodonta orbella** *Gould.*

PLATE XVIII, FIGS. 8 AND 8*a*.

Lucina orbella GLD., Proc. Bost. Soc. Nat. Hist., Vol. IV, 1851, p. 90; Bost. Jour. Nat. Hist., Vol. VI, 1853, p. 395, Pl. XV, fig. 3; Cal. & Mex. Shells, p. 22, Pl. XV, fig. 3.
Diplodonta orbella GLD., GOULD & CARPENTER, Proc. Zool. Soc., 1856, pp. 202, 218. —*(Mysia) Sphairella tumida* CON. (*fide* CPR., Brit. Assn. Rept., 1863, p. 643). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238. KEEP, West Coast Shells, p. 179, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1189.

Shell small, subglobose, thin; beaks nearly median, not prominent; surface sculptured with fine incremental lines, which at some parts are more conspicuous than at others and render the surface somewhat irregular; no distinct lunule; ligament prominent; two cardinal teeth in right valve, of which the anterior is smallest, and the posterior bifid; and two in the left valve, of which the anterior is bifid, and the posterior very oblique; no lateral teeth; muscle-impressions large, faint.

Dimensions.—Long. 11.9 mm.; alt. 11.9 mm.; diam. 9 mm.

Resembles *Lucina tenuisculpta*, but may be distinguished by lack of radiating striæ, and by the prominent cardinal teeth and lack of lateral teeth. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island; and the upper San Pedro series of San Pedro and Crawfish George's. Found also in the Pleistocene of Twenty-sixth Street, San Diego. The specimen figured is from the lower San Pedro series of Deadman Island, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Diego well (Dall).

64. **Diplodonta serricata** *Reeve.*

PLATE XVIII, FIGS. 5 AND 5*a*.

Diplodonta serricata RVE., CPR., Brit. Assn. Rept., 1856, p. 248.

Shell small, orbicular, only slightly convex, thin; umbones central, not prominent; surface sculptured with numerous fine, incremental lines, which are regular in prominence; lunule not distinct; hinge prominent; teeth and interior as in *D. orbella.*

Dimensions.—Long. 13.8 mm.; alt. 14 mm.; diam. 7 mm.

Distinguishable from *D. orbella* by its much less convexity and more regular concentric lines. Specimens identified by Dr. Dall.

Not uncommon in the upper San Pedro series of San Pedro. This species is very common in the Pleistocene deposits at Twenty-sixth Street, San Diego. The specimen figured is from this horizon, and is now in the collection of Delos Arnold.

Living.—Mazatlan (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

Family XXIII. CRYPTODONTIDÆ.

Genus **Thyasira** *Leach.*

Shell globular, posterior side furrowed or angulated; umbones much recurved; lunule short or indistinct; ligament usually and to a certain extent external, placed in a groove on the hinge-line, and outside the hinge-plate; teeth altogether wanting.

Thyasira flexuosus Mont. is a characteristic species.

65. **Thyasira bisecta** *Conrad.*

PLATE XV, FIG. 5.

Venus bisecta CON., Wilkes Expl. Exped., Vol. X, App. 1, p. 724, Pl. XVII, figs. 10, 10*a*, 1849.
Thyatira? bisecta CON., MEEK, Smithsonian Inst., Check-List Mioc. Fossils, 1864.
Cyprina bisecta CON., Jour. Conch., 1865, p. 153.
Conchocele bisecta CON. GABB., Pal. Cal., Vol. II, p. 99, 1869.
Conchocele disjuncta GABB, Pal. Cal., Vol. II, pp. 28, 29, Pl. VII, fig. 48, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 236.
Cryptodon bisectus CON., DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 189; Vol. XVII, 1894, p. 713, Pl. XXVI, figs. 2-5.

Shell large, subquadrate, convex, of medium thickness, equivalve, inequilateral; beaks terminal, anterior; anterior end abruptly and angularly truncated; posterior dorsal margin arcuate, sloping down toward posterior extremity; surface marked only by lines of growth except near the posterior part, where the peculiar truncation takes place, the surface suddenly descending at right angles to the curve of the shell, for a short distance, and then resuming its former direction; ligament long and elliptical; large lunular area in front of the beaks.

Dimensions.—Long. 72 mm.; alt. 62 mm.; diam. 41 mm.

Specimens identified by Dr. Dall.

Gabb describes this shell as occurring in the Miocene of Deadman Island, while Cooper gives its occurrence as in the "Quaternary" of the same place. It is found most abundantly in a hard stratum near the base of the Deadman Island Pliocene deposits; a few shells, however, have been found in Pliocene strata above this layer; found also at Timm's Point in the Pliocene. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound, sixty-nine fathoms (Dall).

Pliocene.—San Pedro (Arnold).

Miocene.—Astoria, Oregon (Conrad): Blakely, near Seattle, Washington (Arnold).

66. **Thyasira gouldi** *Philippi.*

Cryptodon flexuosus (not of MONTAGU) of CARPENTER, Brit. Assn. Rept., 1863, p. 643. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 237.

Shell small, globular, posterior side angulated or furrowed; umbones much recurved; surface sculptured with fine incremental lines; lunule indistinct, depressed in front of beaks; ligament external, placed in a groove on the hinge-line and outside the hinge-plate; teeth wanting.

Dimensions.—Long. 9.5 mm.; alt. 11 mm.; diam. 8 mm.

This species is distinguishable from *T. bisecta* by its much smaller size, more central umbones and less prominent lunule. Dr. Dall says that *T. gouldi* has been mistaken for *Cryptodon flexuosus* by West Coast collectors.

Rather common in the Pleistocene of Dead Man Island and Timm's Point. Not found above the horizon in the San Pedro deposits, so far as known.

Living.—Catalina Island (Cooper): Catalina Island, ten fathoms (Arnold).

Pleistocene.—Santa Barbara (Cooper).

Pliocene.—Santa Barbara; San Diego well (Cooper): San Pedro (Arnold).

Superfamily LEPTONACEA.

Family XXIV. LEPTONIDÆ.

Genus Bornia *Philippi.*

Shell ovate or subtrigonal, subequilateral, with a more or less flattened disk; the periostracum usually brilliant; the surface smooth or divaricately more or less plicate; pallial line not sinuated, and the pallial area piquantly punctate or radially striate; hinge with one moderately long posterior, and two shorter anterior, laminæ in the left valve; in the right, one anterior and one longer, sometimes remote, posterior lamina; one or both of the anterior laminæ in either valve may have the aspect of cardinals; hinge-plate usually excavated.

Type, *Bornia corbuloides* (Phil.).

67. Bornia retifera *Dall.*

PLATE XVII, FIG. 12.

Bornia retifera DALL, Proc. U. S. Nat. Mus., Vol. XXI, 1899, p. 889, Pl. LXXXVII, fig. 2.

Shell thin, white, moderately convex, rounded, trigonal, nearly equilateral; beaks distinct, not high; surface polished, with faint incremental lines and minute, close punctations whose interspaces give the effect of a fine netting; hinge narrow, delicate; one tooth opposite beak, then a depression posterior to this, and then a second tooth completely filling the anterior end of the posterior ligamental groove; adductor scars rounded and high up.

Dimensions—Long. 7 mm.; alt. 5.5 mm.; diam. 3 mm.

Looks like a *Kellia laperousii*, but is distinguishable by the microscopic sculpture and hinge. Specimens identified by Dr. Dall.

One right valve from the lower San Pedro series of Deadman Island, which is figured herewith, and is now in the collection of Delos Arnold.

Living.—Station 2,900, thirteen fathoms, off Santa Barbara (Dall).

Pleistocene.—San Pedro (Arnold).

Genus Kellia *Turton.*

Section *Kellia Turton* s. s.

Shell rounded and inflated, concentrically striated or smooth; with an obsolete external ligament and a large internal resilium without a lithodesma; two anterior and two posterior teeth in each valve, of which the anterior ones are shorter and may be concrescent or free and pustular; interior of valves commonly shows radial striation; and valves frequently distorted.

Type, *Kellia suborbicularis* (Montagu).

68. Kellia laperousii *Deshayes.*

PLATE XVIII, FIGS. 7 AND 7*a*.

Kellia laperousii DESH., CARPENTER, Brit. Assn. Rept., 1863, p. 643. KEEP, West Coast Shells, p. 178, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 191. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1155.

Shell of medium size, suborbicular, convex, thin; umbones slightly anterior, not prominent; surface sculptured by fine incremental lines which are slightly variable as to prominence; no lunule; each valve with one very prominent cardinal tooth; right valve with two posterior laterals, left with one; hinge-area lacking between cardinal and lateral teeth; muscle-impressions not distinct.

Dimensions.—Long. 23 mm.; alt. 19 mm.; diam. 11 mm.

Distinguishable from *K. suborbicularis* by its larger size and less convexity. These two species may be recognized by their thin, suborbicular shells, and the lack of a hinge-area in the region of the umbones, the vacancy at first giving the impression that the hinge-area has been broken. Specimens identified by Dr. Dall.

Rare in lower San Pedro series of San Pedro and Deadman Island. One perfect valve from the Pliocene at Deadman Island. Found also in the Pleistocene of Spanish Bight, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound to Monterey (Carpenter).

Pleistocene.—San Pedro (Arnold): San Diego (Arnold).

Pliocene.—San Pedro (Arnold).

69. Kellia suborbicularis *Montagu.*

PLATE XVIII, FIGS. 1 AND 1*a*.

Kellia suborbicularis MONT., Testacea Britannica, pp. 39, 564, Pl. XXVI, fig. 6, 1804. CARPENTER, Brit. Assn. Rept., 1863, p. 643. TRYON, Syst. Conch., Vol. III, p. 220, Pl. CXX, fig. 2, 1884. KEEP, West Coast Shells, p. 177, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 191. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1155.

Shell small, suborbicular, deeply convex, thin; beaks small, slightly anterior; surface ornamented with fine lines of growth which become somewhat irregularly constricted near margin, roughening the surface; no lunule; margins smooth; hinge and teeth as in *K. laperousii.*

Dimensions.—Long. 8.4 mm.; alt. 7.4 mm.; diam. 5.8 mm.

Distinguishable from *K. laperousii* by smaller size and greater convexity. Specimens identified by Dr. Dall.

Rare in lower San Pedro series of San Pedro and Deadman Island. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound to Lower California; England (Carpenter).

Pleistocene.—San Pedro (Arnold).

Family XXV. KELLIELLIDÆ.

Genus **Aligena** *H. C. Lea.*

Shell rounded, triangular, inflated; single small anterior tooth under the beaks, separated by a gap from the surface of attachment, under the posterior dorsal margin, of an elongate internal resilium carrying a lithodisma.

Type, *Aligena striata* (Lea).

70. **Aligena cerritensis**, sp. nov.

PLATE XIII, FIG. 3.

Shell small, rounded, triangular, inflated, thin; inequilateral, the umbo being nearly terminal posteriorly; anterior dorsal margin nearly straight; anterior extremity quite sharply rounded and produced furthest below middle; posterior extremity sloping off abruptly from umbo and rounded near base; ventral margin arcuate; surface with faint concentric sculpture; umbones small, pointed, anteriorly twisted, with a minute tooth below them on the cardinal margin; pallial line entire; muscle-scars subequal.

Dimensions.—Long. 8.5 mm.; alt. 8 mm.; diam. 5 mm.

This species resembles *Acila castrensis* in outline. Specimens identified by Dr. Dall, who pronounced it a new species.

Two specimens from the upper San Pedro series of Los Cerritos, one of which is the type, which is figured, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Superfamily CARDIACEA.

Family XXVI. CARDIIDÆ.

Genus **Cardium** *(Linné) Lamarck.*

Shell variably sculptured, usually with predominantly radial ornamentation, usually closed or gaping but slightly, with no lunule or escutcheon; pallial line rather distant from the margin of the valves.

Subgenus **Trachycardium** *Mörch.*

Shell rotund, closed, with the ribs imbricate or granulose; the channels also sometimes granulose; left cardinals anterior when interlocked.

Type, *Cardium isocardia* (Linné).

71. **Cardium (Trachycardium) quadrigenarium** *Conrad.*

Cardium quadrigenarium CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 230, Pl. XVII, fig. 5; = *luteolabrum* GLD. (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 642). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, page 232. KEEP, West Coast Shells, p. 192, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190. DALL, Trans. Wagner Inst. Sci., Vol. III, Part. 5, 1900, p. 1091.

Shell large, oval, ventricose, thick; umbones central, prominent, turned only slightly anteriorly; surface sculptured with about forty prominent, subangular, smooth, radiating ridges, which are roughened by prominent pointed tubercles on their posterior angle; those ridges near the posterior margin are less prominent, but are nodose for nearly their whole length; teeth and interior as in *C. corbis;* margin sharply serrated.

Dimensions.—Long. 105 mm.; alt. 105 mm.; diam. 86 mm.

Distinguishable by large size and tuberculated ridges. Specimens identified by Dr. Dall.

Found in the upper San Pedro series of San Pedro, Los Cerritos and the Long Beach bluff. Found also in the Pleistocene of Twenty-sixth Street and Pacific Beach, San Diego.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper; Arnold).

Pliocene.—Calleguas Ranch, Ventura County (Cooper).

Subgenus **Ringicardium** *Fischer.*

Shell rotund, gaping, with flat ribs and channels, the posterior area with granulose channels; posterior margin sharply spinose, the spines crossing each other over the gap; left cardinals when interlocked posterior to the right ones.

Type, *Cardium ringens* (Gmel.).

72. **Cardium (Ringicardium) procerum** *Sowerby.*

PLATE XV, FIG. 6.

Cardium procerum SBY., CARPENTER, Brit. Assn. Rept., 1863, p. 620. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1091.

Cardium panamense, not of SBY., of COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 232.

Shell of medium size, suboval, of medium thickness, ventricose, with a rather angular appearance at about one-fourth the length from the anterior margin; surface sculptured by about 22 subangular, smooth radiating ridges, with narrow, canel-like grooves between; each valve with three very prominent sharp teeth; margin sharply serrate.

Dimensions—Long. 1 mm.; alt. 23 mm.; diam. 19 mm.

Distinguishable by angular appearance near anterior side, and by the comparatively small number of smooth radiating ridges. Specimens identified by Dr. Dall.

Rather common in the upper San Pedro series of San Pedro, Long Beach and Los Cerritos; one specimen from the lower San Pedro series of Deadman Island. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold. Found abundantly in the Pleistocene of Twenty-sixth Street and Spanish Bight, San Diego.

Living.— Gulf of California to Panama (Dall).

Pleistocene. San Pedro (Cooper; Arnold): San Diego (Cooper; Dall; Arnold).

Subgenus **Cerastoderma** *Mörch.*

Shell rotund or obovate, closed; with strong ribs obsoletely granulose or intricate or smooth; no posterior or anterior area; channels single; hinge normal.

Type, *Cardium edule* (Linné).

73. **Cardium (Cerastoderma) corbis** *Martyn.*

Pectunculis corbis MART., Univ. Conch., Pl. XXVIII, fig. 2, p. 1784.

Cardium corbis MART., CARPENTER, Brit. Assn. Rept., 1863, p. 642, =*C. californicum* CON. =*C. nuttalli* CON. (*fide* GABB, Pal. Cal, Vol. II. p. 98, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 232. KEEP, West Coast Shells, p. 180, fig. 153. 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1093.

Shell large, subtrigonal, ventricose, thick; umbones prominent, anterior to center; surface ornamented with about thirty-seven prominent, regular, squarish, close-set, radiating ridges, which are made more or less rugose by incremental ridges on their surface; near the posterior margin these ridges become more rounded and less prominent; between the ridges are equal, deep, canal-like grooves; margin crenulated; ligament short, external, prominent; each valve with one prominent cardinal tooth, and two laterals, one anterior and the other posterior; muscle impressions prominent, subequal.

Dimensions.—Long. 71 mm.; alt. 71 mm.; diam. 57 mm.

Distinguishable by the regular, only slightly rugose ridges. Specimens identified by Dr. Dall.

Found in the lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of Deadman Island, San Pedro, Los Cerritos and Crawfish George's. Found also in the Pleistocene of the bath-house, Santa Barbara.

Living.— Kodiak to Santa Barbara; Kamtschatka (Cooper).

Pleistocene. San Francisco; Monterey; San Pedro (Cooper): San Pedro; Santa Barbara (Arnold).

Subgenus **Lævicardium** *Swainson.*

Shell thin, oval, closed; middle of the valves smooth or feebly radially sculptured; ends with a smooth area; hinge normal, but with the anterior laterals springing from the umbonal cavity; periostracum smooth.

Type, *Cardium norvegicum* (Spengler).

74. **Cardium (Lævicardium) elatum** *Sowerby.*

PLATE XX.

Cardium elatum SBY., Conch Ill., Vol. I, 1838. REEVE, Conch. Icon., Pl. VIII, fig. 41. VALENCIENNES, Voy. Venus, Pl. XVII, fig. 1, 1846.

Liocardium elatum SBY., CARPENTER, Brit. Assn. Rept., 1863, p. 642. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 246. KEEP, West Coast Shells, p. 181, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190.

Lævicardium elatum SBY., GABB, Pal. Cal., Vol. II, p. 99, 1869. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1111.

Shell large, oval, oblique, elongated, equivalve, somewhat inequilateral; surface sculptured by numerous faint, squarish, radiating ribs, and fine, wavy incremental lines; inner surface of margin corrugated; hinge strong, with one prominent cardinal and one prominent anterior lateral tooth in each valve; muscle-impressions distinct.

Dimensions.—Long. 144 mm.; alt. 167 mm.; diam. 136 mm.

This is the largest of the *Cardiidæ*, and is easily recognizable by its immense size and nearly smooth surface. A fine pair of this species, described above, and figured, was found in the upper San Pedro series at the north end of the San Pedro bluff. Another specimen was obtained by Dr. A. A. Wright and Mrs. Oldroyd in the upper San Pedro deposits of Los Cerritos. This species is one of the typical southern forms found in the upper San Pedro series.

Living.—San Pedro to Mazatlan (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego (Gabb; Dall).

75. **Cardium (Lævicardium) substriatum** *Conrad.*

Cardium substriatum CON., Jour. Phil. Acad. Sci, Vol. VII, 1837, p. 228, Pl. XVII, fig. 2.

Liocardium substriatum CON, = *cruentatum* GOULD, (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 642.) COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 246. KEEP, West Coast Shells, p. 181, fig. 154, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 190.

Lævicardium substriatum CON., GABB, Pal. Cal., Vol. II, p. 99, 1869. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, page 1111.

Shell small, obliquely ovate, ventricose, thin; surface smooth, except for minute incremental lines and nearly obsolete radiating striæ; one small sharp cardinal tooth in each valve; two narrow elongated lateral teeth in each valve, the posterior one in the left valve not prominent; interior of margin finely crenulated.

Dimensions.—Long. 17 mm.; alt. 18 mm.; diam. 13 mm.

Distinguishable by its small size and smooth surface. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island and San Pedro, and in the upper San Pedro series of Deadman Island, San Pedro, Crawfish George's, and Los Cerritos. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—Monterey to South America (Cooper).

Pleistocene.—Santa Barbara; San Pedro; San Diego (Cooper): San Pedro (Arnold): San Diego (Arnold).

Genus **Protocardia** *Beyrich.*

Shell globose, with a posterior area sharply distinguished by sculpture from the rest of the surface; closed; hinge normal; no lunule or escutcheon.

Type, *Cardium hillanum* (Sowerby).

76. **Protocardia centifilosa** *Carpenter.*

Cardium var. *centifilosum* Cpr., Brit. Assn. Rept. 1863, p. 642.
Cardium centifilosum Cpr., Gabb, Pal. Cal., Vol. II, p. 99, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 232. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 189.
Protocardia centifilosa Cpr., Dall, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1113.

Shell small, suboval, ventricose, thin; umbones central, prominent, only very slightly bent; surface sculptured by numerous fine, close-set, rounded, radiating ridges, which are made slightly rugose by numerous fine, incremental lines on their surface; thin, sharp teeth in each valve; pallial sinus shallow, wide; margin beautifully and sharply serrate.

Dimensions.—Long. 23 mm.; alt. 22.5 mm.; diam. 15 mm..

Distinguishable by the nearly circular outline and numerous fine, radiating ridges. Specimens identified by Dr. Dall.

Not uncommon in the Pliocene of Deadman Island and Timm's Point; rare in the lower San Pedro series of Deadman Island. Found also in the Pleistocene at bath-house and the Pliocene of Packard's Hill, Santa Barbara.

Living.—Monterey to Catalina Island (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): Santa Barbara (Arnold).

Pliocene.—San Pedro (Arnold): San Diego well (Dall): Santa Barbara (Arnold).

Pliocene.—Sunol, Alameda County (Cooper).

Superfamily VENERACEA.

Family XXVII. VENERIDÆ.

Subfamily VENERINÆ.

Genus **Tivela** *Link.*

Shell triangular, subequilateral, cuneiform; three to five cardinal teeth in one valve, four to six in the other; anterior lateral tooth narrow, elongated, compressed; pallial impression with a short oblique or sometimes horizontal sinus.

Cytherea is a characteristic species.

77. **Tivela crassatelloides** *Conrad.*

Cytherea (*Trigonella*) *crassatelloides* CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 253, Pl. XIX, fig. 17. HINDS, Voyage Sulpher, p. 65, Pl. XXI, fig. 1, 1844.

Donax stultorum MARVE, LINN., Lyst. Conch., pp. 37, 40, Pl. IX, fig. 7, 1823. GRAY, Index. Test. Suppl., Pl. II (*Donax*), fig. 2, 1828.

Cytherea crassatelloides CON., HANLEY, Descr. Cat. Rec. Bivalve Shells, p. 106, 1843. SOWERBY, Thes. Conch., Vol. II, p. 612, Pl. CXXVII, figs. 1–3. REEVE, Icon. Conch., Vol. XIV, Pl. I, fig. 3, 1864.

Cytherea stultorum GRAY, HANLEY, Descriptive Cat. Rec. Bivalve Shells, p. 106, 1843.

Trigonella crassatelloides CON., Jour. Phil. Acad. Sci., Vol. I, 1849, p. 213.

Trigonia crassatelloides CON., DESHAYES, Cat. Conch. Coll. B. M., Part 1, p. 46, 1853.

Trigonia stultorum GRAY, DESHAYES, Cat. Conch. Coll. B. M., Part 1, p. 46, 1853.

Pachydesma crassatelloides CON., Proc. Phil. Acad. Sci., 1854, p. 121. CARPENTER, Brit. Assn. Rept. 1863, p. 640; =*Cytherea solidissima* PHIL., GABB, Pal. Cal. Vol. II, p. 96, 1869. COOPER, 7th. Ann. Rept. Cal. St. Min., 1888, p. 256. KEEP, West Coast Shells, p. 189, fig. 162, 1892.

Tivela crassatelloides CON., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 187.

Cytherea (*Tivela*) *crassatelloides* CON., STEARNS, Proc. U. S. Nat. Mus., Vol. XXI, 1898, pp. 371–378, Pl. XXIII–XXV. STEARNS, Nautilus, Vol. XIII, 1899, p. 73.

Shell large, subequilateral, trigonal, depressed, thick; umbones subcentral, small; anterior extremity shorter and more obtusely rounded than posterior; anterior dorsal margin nearly straight, slopes down obliquely from umbo; posterior dorsal margin slightly concave in front of umbo, slope less than anterior; posterior extremity narrower than anterior; three prominent, thick, cardinal teeth in each valve, anterior lateral tooth elongated; pallial sinus short, angular.

Dimensions.—Long. 80 mm.; alt. 55 mm.; diam. 30 mm.

The Pleistocene specimens have a tendency toward more central umbones than do the living forms. This species is distinguishable from the Mactras by its very thick shell and heavy cardinal teeth. Specimens identified by Dr. Dall.

Common in the upper San Pedro series of San Pedro, Los Cerritos, Long Beach, Crawfish George's and Deadman Island; rare in the lower San Pedro series of Deadman Island. Found also in the Pleistocene of Twenty-sixth Street and Spanish Bight, San Diego.

Living.—Santa Cruz to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego; (Arnold).

Genus **Callista** *Poli.*

Shell oval, transverse, inequilateral; pallial sinus suboval, profound.

Cytherea erycina Linn. is a characteristic species.

78. **Callista newcombiana** *Gabb.*

Lioconcha newcombiana GABB, Proc. Cal. Acad. Sci., 1865, p. 189; Pal. Cal., Vol. II, p. 96, 1869.

Callista newcombiana GABB, COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 187, Pl. XXIII, fig. 4.

Shell thin, trigonally ventricose, polished, marked by minute concentric striæ; beaks large, subcentral; anterior end prominent, narrowly rounded; posterior end a little the widest; base arcuate;

lunule not excavated, but bounded by an impressed line; hinge not strong; two small cardinal teeth; ligamental area excavated, internal.

Dimensions.—Long. 38 mm.; alt. 30 mm.; diam. 10 mm.; length of lunule 12 mm.

This species is distinguishable from *C. subdiaphana* Carpenter by its prominent impressed lunule-bounding line, rounded pallial sinus, and by its coloration in the living specimens.

Rare in upper San Pedro series at Deadman Island. Abundant at Twenty-sixth Street, San Diego.

Living.—Monterey to Catalina Island (Cooper): San Pedro (Williamson).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper; Arnold).

Pliocene.—San Diego well (Cooper).

79. Callista subdiaphana *Carpenter.*

PLATE XIII, FIG. 1.

Clementia subdiaphana CPR., Brit. Assn. Rept. 1863, p. 640; Proc. Phil. Acad. Sci., 1865, p. 56. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 235. DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 185, Pl. VII, figs. 5 and 6.

Shell of medium size, oval, transverse, inequilateral, ventricose, rather thin; beaks small, incurved; anterior extremity quite sharply angulated about middle of shell; posterior extremity much longer and wider than anterior and very evenly rounded, projecting furthest a little below the middle; ventral margin evenly arcuate; surface sculptured by numerous fine, regular, concentric, incremental lines; neither lunule nor escutcheon, but a faint lunular circumscribing line in front of umbo; three prominent, sharp, cardinal teeth in each valve, the anterior one being narrower and longer than the other two; external ligamental groove long, narrow; pallial sinus cuneiform, rather deep.

Dimensions.—Long. 43.5 mm.; alt. 34 mm.; diam. 26 mm; umbo to anterior extremity 10 mm.; to posterior extremity 33.5 mm.

This species is very close to Conrad's *Dione angustiformis* from the Astoria Miocene, the external characteristics of both being almost identical. Specimens identified by Dr. Dall.

Rather common in the Pliocene of Deadman Island and Timm's Point. Cooper's "Quarternary" at San Pedro includes the Pliocene, and his specimens from San Pedro were probably from the Pliocene. The writer has never found *Callista subdiaphana* in the Pleistocene of San Pedro or vicinity. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—South Alaska Coast to San Francisco (Dall).

Pleistocene.—San Pedro to San Diego (Cooper).

Pliocene.—San Diego well (Cooper): San Pedro (Arnold).

80. Callista subdiaphana *Carpenter*, pedroana, var. nov.

PLATE XIII, FIG. 2.

Shell of medium size, subelliptical, transverse, inequilateral, ventricose, rather thin; beaks small, incurved; anterior extremity evenly rounded, short; posterior extremity faintly biangular, caused by a slight, very oblique truncation across the middle of the extremity; posterior portion of the ventral line nearly straight; interior the same as in *C. subdiaphana*.

Dimensions.—Long. 32.5 mm.; alt. 24 mm.; diam. 15 mm.

This variety is very distinct from the typical *C. diaphana*, being much narrower, less ventricose and smaller; and having a shorter, more rounded anterior extremity, a biangular posterior extremity, and a nearly straight ventral margin.

This variety has been found only in the lower San Pedro series of Deadman Island.

Pleistocene.—San Pedro (Arnold).

Subgenus **Amiantis** *Carpenter.*

Fulcra very thick and surface very concentrically rugose.

Type, *Cytherea callosa* Conrad.

81. **Callista (Amiantis) callosa** *Conrad.*

Cytherea callosa CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 252.

Venus callosa CON., SOWERBY, Thes. Conch., Vol, II, p. 712, Pl. CXIV, figs. 44, 45.

Dosinia callosa CON., CARPENTER, Proc. Zool. Soc., 1856, p. 216.

Amiantis callosa CON., CARPENTER, Brit. Assn. Rept., 1863, p. 640. GABB., Pal. Cal., Vol. II, p. 96, 1869. TRYON, Syst. Conch., Vol. III, p. 178, 1884. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 266. KEEP, West Coast Shells, p. 187, fig. 160, 1892. COOPER, Bull. No. 7, 1894, Cal. St. Min. Bureau, p. 24.

Meretrix callosa CON., FISCHER, Conchologie, p. 1079, 1887.

Callista (Amiantis) callosa CON.; =*Dione nobilis* RVE. (*fide* DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 187).

Shell large, suboval, inequilateral, equivalve, heavy; umbones anterior to center, prominent, recurved; anterior dorsal margin slightly concave; anterior extremity quite sharply rounded near upper margin; ventral margin evenly arcuate; posterior dorsal margin slightly arcuate; posterior extremity faintly biangular; surface sculptured by numerous prominent, flat-topped, concentric ridges, between which are interspaces equal in width to the ridges; lunule distinct, concentrically striated; hinge heavy; two prominent, strong cardinal teeth; pallial sinus wide, deep and rather pointed.

Dimensions.—Long. 66 mm.; alt. 55 mm.; diam. 34 mm.; umbo to anterior extremity 20 mm.; to posterior extremity 46 mm.

Cooper (Seventh Ann. Rept. Cal. St. Min., p. 266) says that this species is like *Tapes montana*, described by Conrad from the "Miocene of San Buenaventura." Specimens identified by Dr. Dall.

Common in the upper San Pedro series of Los Cerritos, but exceedingly rare in the same horizon of San Pedro. This species is very abundant in the Pleistocene at Spanish Bight, San Diego.

Living.—Santa Barbara to Lower California (Carpenter).

Pleistocene.—San Pedro (Arnold): San Diego (Arnold).

Subfamily *Dosininæ*.

Genus **Dosinia** *Scopoli*.

Shell orbicular, compressed, concentrically striated, pale, ligament sunk; lunule deep; hinge like *Cytherea:* margin even; pallial sinus deep, angular, ascending.

Dosinia discus Reeve is a characteristic species.

[S. D.] **Dosinia ponderosa** *Gray*.

Artemis ponderosa GRAY, Analyst, Vol. VIII, 1838, p. 309.

Dosinia ponderosa GRAY, H. & A. ADAMS, Gen. Rec. Moll., Vol. II, p. 432; =*Cytherea gigantea* SBY. (*fide* GABB, Pal. Cal. Vol. II, p. 97, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 239.

Shell large, thick, equivalve, subcircular in outline, convex; surface sculptured by many obsolete, concentric lamellæ, and fine, incremental lines; lunule deeply impressed, small, finely sculptured; beaks small, not elevated; hinge very wide and heavy, with three heavy, cardinal teeth, the posterior one in the right valve being bifid; ligament long, narrow, sunken.

Dimensions.—Long. 119 mm.; alt. 105 mm.; diam. 55 mm.; lunule 15 mm.

Common in the upper San Pedro series (Pleistocene) of Twenty-sixth Street, San Diego.

Living.—West Mexican coast to Panama (Carpenter).

Pleistocene.—San Diego (Hemphill; Arnold).

Pliocene.—Kirker's Pass, Contra Costa County; San Fernando (Cooper): Stanford University, Santa Clara County (Arnold).

Genus **Venus** *Linné*.

Shell thick, ovate, smooth, sulcated, or cancellated; margins minutely crenulated; cardinal teeth three in each valve; pallial sinus small, angular; ligament prominent; lunule distinct.

Venus verrucosa Linné is a characteristic species.

[S. B.] **Venus perlaminosa** *Conrad*.

Mercenaria perlaminosa CON., Proc. Phil. Acad. Sci., 1855, p. 267. GABB, Pal. Cal.. Vol. II, pp. 22, 55, 94; Pl. V, fig. 38; Pl. XV, fig. 14; 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 250.

Venus kennerleyi RVE., Icon. Conch. (*Venus*), Pl. XII, fig. 41 (*fide* GABB).

"Shell large, thick, rounded, subquadrate, very inequilateral; beaks anterior; anterior end excavated under the beaks, rounded below; base broadly rounded; posterior end convexly truncated; cardinal margin slightly convex. Surface closely marked by numerous prominent, recurved, lamelliform concentric ribs. Lunule marked by an impressed line, Hinge robust. Pallial line strong, sinus small, oblique, acute at base; muscular scars nearly equal in size; margin minutely crenulated; the purple color between the pallial line and the base is very persistent."—[GABB.]

Found in the Pliocene at Packard's Hill, and in the Pleistocene at the bath-house, Santa Barbara.

Subgenus **Chione** *Megerle.*

Shell oval, triangular or subcordiform; margins finely crenulated; hinge narrow, solid, with three teeth in the right valve and two in the left, the anterior tooth longest; ligament narrow; pallial sinus shallow.

Venus gnidia Brod. is a characteristic species.

82. **Venus (Chione) fluctifraga** *Sowerby.*

PLATE XIV, FIG. 2.

Venus fluctifraga SBY., Thes. Conch., 1842-1859.

Chione fluctifraga SBY., +*C. callosa* SBY.; = *Venus cortezi* SLOAT; = *V. gibbosula* (DESH.) RVE. (*fide* CARPENTER, Brit. Assn. Rept., 1863, pp. 641, 666). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. KEEP, West Coast Shells, p. 187, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell of medium size and thickness, suboval; surface roughened by radiating rows of squarish blocks, this condition being caused by wide concentric ridges being cut by radiating sulcations; spaces between the concentric ridges ornamented by fine, even, incremental lines; lunule of same sculpture as shell, scarcely differentiated; two prominent teeth and a rudimentary anterior one in the right valve; pallial sinus quite deep; muscle-impressions elongate-oval.

Dimensions.—Long. 25 mm.; alt. 21 mm.; diam. 15 mm.

Distinguishable from others of this genus found in these beds by being more swollen, oval rather than cordiform in shape, thinner shelled, by the "blocked" surface, and by the lunule being scarcely differentiated from the rest of the shell. Specimen identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; one specimen, a right valve, which is figured, and is now in the collection of Delos Arnold. Common in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—San Pedro to San Diego; Gulf of California (Cooper).

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro; San Diego (Arnold).

83. **Venus (Chione) gnidia** *Broderip & Sowerby.*

PLATE XIV, FIG. 7.

Venus gnidia SBY., Gen. Rec. & Fos. Shells (*Veneridæ*), fig. 7, 1824.

Venus gnidia BROD. & SBY., Zool. Jour., Vol. IV, 1829, p. 364; Zool. Beechey's Voyage, p. 151, Pl. XLI, fig. 3, 1839. REEVE, Syst. Conch., Vol. I, fig. 5, 1841. CARPENTER, Brit. Assn. Rept., 1856, p. 175; 1863, p. 561.

Chione gnidia BROD. & SBY., TRYON, Syst. Conch., Vol. III, p. 176, Pl. CXIII, fig. 14, 1884.

Shell large, thick, subcordiform; surface ornamented by several prominent, palmate, concentric frills and numerous squarish, radiating ribs between which are canal-like sulcations of about equal width with the ribs; the ribs are sharper in outline near the beak and multiply in number both by division and intercalation as the margin is approached; near the periphery, and also on the anterior portion of the shell, the ridges become wider and less prominent, and in some cases almost obsolete; the concentric frills become widely separated in the adult shell; lunule prominent, shows fine laminæ of growth which are most prominent when projections of the frills; hinge narrow, solid; three cardinal teeth in right valve, two in left; ligament narrow; pallial sinus much shorter than lunule; muscle-impressions distinct.

Dimensions.—Long. 98 mm.; alt. 83 mm.; diam. 62 mm.; lunule 18 mm.

This is the largest of the genus found in these deposits and is easily distinguishable by its size, prominent concentric frills and numerous radiating ribs. The specimen whose dimensions are given above had twenty-four concentric frills and about ninety radiating ribs. Specimens identified by Dr. Dall.

Rare in the upper San Pedro series of San Pedro, whence the specimen figured came. This specimen is now in the collection of Delos Arnold.

Living.—Gulf of California to Panama (Carpenter).

Pleistocene.—San Pedro (Arnold).

84. Venus (Chione) neglecta *Sowerby.*

PLATE XIV, FIG. 3.

Venus neglecta SBY., Thes. Conch., 1842–1849. CARPENTER, Brit. Assn. Rept., 1856, p. 306.

Shell of medium size and thickness, suboval; surface ornamented with quite numerous, about equidistant, undulating, concentric, low frills, and numerous unequal, rounded, radiating ridges, which are most prominent on the middle of the shell; lunule prominent, ornamented with minute concentric and radiating sculpture; hinge and pallial sinus are as in *C. succinta.*

Dimensions.—Long. 29.5 mm.; alt. 24 mm.; diam. 13 mm ; lunule 6 mm.

This species is close to *C. succincta*, but may be differentiated by its more oval outline, thinner shell, relatively less diameter, and less prominent but more numerous concentric frills. Specimen identified as "probably *C. neglecta*" by Dr. Dall.

Rare in upper San Pedro series of San Pedro and Los Cerritos. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Gulf of California and Central America (Carpenter).

Pleistocene.—San Pedro (Arnold).

85. Venus (Chione) simillima *Sowerby.*

Venus simillima SBY., Thes. Conch., p. 708, Pl. CLIII, figs. 17, 18, 1842–1859.

Chione simillima SBY., CARPENTER, Brit. Assn. Rept., 1863, p. 641. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. KEEP, West Coast Shells, p. 186, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell of medium size, thick, subcordiform; surface ornamented by numerous slightly crenulated, reflexed, concentric frills, which grow closer and closer together as the periphery is approached, and by about twenty bifurcated, radiating ridges, which are largest in the middle of the shell, becoming obsolete anteriorly and posteriorly, and increasing in number, but fading out as the periphery is approached; lunule prominent. ornamented with incremental laminæ; hinge narrow; only two prominent cardinal teeth on each valve; pallial sinus very shallow; margin crenulated.

Dimensions.—Long. 40 mm.; alt. 35 mm.; diam. 25 mm.; lunule 9 mm.

Distinguishable from others of this genus occurring in these deposits by the even, close, lattice-like sculpture. Specimens identified by Dr. Dall.

Common in upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, and Deadman Island; rare in the lower San Pedro series at Deadman Island. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—Monterey to Lower California (Carpenter).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

86. **Venus (Chione) succincta** *Valenciennes.*

PLATE XIV, FIG. 1.

Venus succincta VAL., HUMB. & BONPL., Obs. sur Zool., p. 219, Pl. LXVIII, fig. 1, 1833.

Chione succincta VAL. = *C. californiensis* BROD. = *C. nuttalli* CON. (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 641.)

Chione succincta VAL. = *Venus californica* CON. = *V. nuttalli* CON. = *V. lamellifera* CON. (Wilkes' Exped. and Jour. Conch., 1865; not *V. lamellifera* CON., Jour. Phil. Acad., Vol. VII, which = *Tapes staminea* var. *ruderata*) = *V. brevilineata* CON. = *Chione brevilineata* CON. = *V. securis* SHUM. (*fide* GABB, Pal. Cal., Vol. II, p. 94, 1869). COOPER, 7th Ann. Rept Cal. St. Min., 1888, p. 234. KEEP, West Coast Shells, p. 187, fig. 159, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell of medium size, thick, subcordiform; surface ornamented by several about equidistant, slightly reflexed, low, concentric frills and numerous rounded, radiating ridges, most prominent on the middle of the shell, which increase by intercalation and become flattened and less prominent as the periphery is approached; lunule prominent, ornamented by both incremental laminæ and rounded, radiating ridges; hinge narrow; two prominent cardinal teeth in each valve; pallial sinus very shallow; margin crenulated.

Dimensions.—Long. 55 mm.; alt. 50 mm.; diam. 32 mm.; lunule 13.5 mm.

The specimen whose measurements are given was the largest of the specimens examined. Distinguishable by the equidistant concentric frills, low, rounded, radiating lines, and radiating lines on the lunule.

Rather common in upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's and Deadman Island. Found also in the Pleistocene of Barlow's ranch, Ventura, and Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego; Mexico; South America (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—Seven Mile Beach, San Mateo County; San Fernando (Cooper).

Miocene.—Oregon; Martinez; San Pablo; Griswold's, San Benito County; Foxin's, Santa Barbara County; Santa Monica (Cooper).

Superfamily TAPETINÆ.

Genus **Tapes** *Megerle.*

Shell oblong, umbones anterior; margins smooth; teeth three in each valve, more or less bifid; pallial sinus deep, rounded.

Tapes litterata Linné is a characteristic species.

87. Tapes laciniata *Carpenter.*

PLATE XIV, FIG. 5.

Tapes laciniata CPR., Brit. Assn. Rept., 1863, p. 641; Jour. de Conch., Vol. XII, 1865, p. 136 KEEP, West Coast Shells, p. 186, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell large, oval, swollen, thick, but brittle; surface net-like, caused by prominent, thick rounded, concentric frills, and numerous rounded, radiating ridges; margin smooth; hinge and interior parts as in *T. staminea.*

Dimensions.—Long. 80 mm.; alt. 68 mm.; diam. 56 mm.

Resembles *T. staminea* in outline, but is much larger, heavier, and more brittle, and has a much more decided cancellate sculpture.

Rare in upper San Pedro series at San Pedro, but rather common at Los Cerritos in the same horizon. The specimen figured is from the upper San Pedro series at Los Cerritos, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

88. Tapes staminea *Conrad*

PLATE XIV, FIG. 4.

Venus staminea CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 250, Pl. XIX, fig. 15,

Tapes staminea CON., CARPENTER, Brit. Assn. Rept., 1863, p. 641; = *V. lamellifera* CON., (Jour. Phil. Acad., Vol. VII, 1837; not of Wilkes' Exped.); = *T. diversum* CON.; = *T. lineatum* CON.; = *Venus rigida* GLD. (*fide* GABB, Pal. Cal., Vol. II, p. 97, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 266. KEEP, West Coast Shells, p. 185, fig. 158, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell of medium size and thickness, suboval, convex; surface sculptured with numerous, crowded, rounded, radiating ridges, and concentric lines, which are most prominent on anterior end; no lunule; margin sometimes crenulated; hinge narrow; ligament narrow, long; three teeth in each valve; posterior two in right valve and middle one in left valve bifid; pallial sinus long, rounded; muscle-impressions not sunken.

Dimensions.—Long. 50 mm.; alt. 42.5 mm.; diam. 30 mm.

This is a variable species, the shape of the shell and the sculpture varying in different individuals. The form above described is the most common in the San Pedro beds. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island and San Pedro; common in the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, Crawfish George's and Long Beach. The specimen figured is from the upper San Pedro series of San Pedro and is now in the collection of Delos Arnold. Found in the Pliocene at Pacific Beach and Russ School; and in the Pleistocene at Twenty-sixth Street and Spanish Bight, San Diego.

Living.—Straits of Fuca to Lower California (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—Santa Rosa; Twelve Mile House, San Mateo County; Kirker's Pass, Contra Costa County; Monterey; San Fernando (Cooper); San Diego (Arnold).

Miocene.—West of San Jose; Foxin's, Santa Barbara County (Cooper).

89. **Tapes tenerrima** *Carpenter.*

PLATE XIV, FIG. 6.

Tapes tenerrima CPR., Proc. Zool. Soc., 1856, p. 200; (jun.) = *Venus rigida* GLD., pars. (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 641.) GABB, Pal. Cal., Vol. II, p. 97, 1869 COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 267. KEEP, West Coast Shells, p. 157, fig, 136, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell large and thin, oval, convex; surface sculptured by numerous low, sharp, concentric frills, and numerous fine, rounded, crowded, radiating lines, these latter lines being almost obsolete in some specimens; margin smooth, hinge long and narrow; three teeth in each valve, the anterior two in the right valve and the middle one in the left valve prominently bifid; pallial sinus very deep and rounded; no lunule.

Dimensions.—Long. 86 mm.; alt. 63.5 mm.; diam. 34 mm.

This is the largest and finest *Tapes* found in these deposits, and is easily distinguishable by its large, thin, shallow shell and regular, oval outline. Specimens identified by Dr. Dall.

Rather rare in the upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's and Deadman Island. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold. Found also in the Pleistocene at Barlow's ranch, Ventura, and at Spanish Bight, San Diego.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—Santa Barbara (Cooper).

Genus **Saxidomus** *Conrad.*

Shell transversely oval, inequilateral, solid, ventricose; without lunule; umbones tumid; teeth three or four, inequal, narrow, the central bifid; ligament very thick, elongated; muscular impressions oval or rounded, nearly equal; pallial sinus large, elongated, horizontal.

Type, *Saxidomus nuttallii* (Con.).

90. **Saxidomus aratus** *Gould.*

Saxidomus aratus GLD., Otia Conch., p. 168, 1862. CARPENTER, Brit. Assn. Rept., 1863, p. 641. KEEP, West Coast Shells, p. 183, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Tapes gracilis GLD., Pac. R. R. Rept., Vol. V., p. 333, Pl. XIX, fig. 20, 1853.

Saxidomus gracilis, GLD., = *Venus maxima* PHIL. (*fide* GABB, Pal. Cal., Vol. II, 1869, p. 98). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 263.

Shell large, transversely elliptical, equivalve, inequilateral, convex, thick; umbones turned, anterior to middle; anterior end evenly rounded; posterior end much more produced, having a slight tendency toward biangulation; surface sculptured with strong, elevated concentric lines, which in the adult often have the prominence of concentric lamina; ligamental area external, wide, long, strong; cardinal teeth four, anterior one long and narrow; pallial sinus long, rather narrow, rounded extremity near middle of shell and impressed against the posterior adductor scar.

Dimensions.—Long. 89 mm.; alt. 62 mm.; diam. 44 mm.; umbo to anterior extremity 30 mm.; to posterior extremity 59 mm.

Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island; common in the upper San Pedro series at Deadman Island, Crawfish George's, Los Cerritos and San Pedro. Found also in the Pleistocene at Barlow's ranch, Ventura, and at Twenty-sixth Street, San Diego.

Living.—Baulines Bay to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Blakeley, near Seattle, Washington (Arnold): San Diego; Ventura (Arnold).

Pliocene.—Kirker's Pass, Contra Costa County; Twelve Mile House, San Mateo County; Santa Barbara, San Fernando (Cooper).

Miocene.—Martinez; Walnut Creek, Contra Costa County; Santa Cruz; Santa Inez, Santa Barbara County; Santa Monica (Cooper).

Subfamily GEMMINÆ.

Genus **Psephis** *Carpenter.*

Shell thin, rounded or quadrangular, somewhat inflated; pallial sinus small; three elongated, thin, cardinal teeth in each valve.

Psephis lordi (Baird) is a characteristic species.

91. **Psephis salmonea** *Carpenter.*

Psephis salmonea Cpr., Brit. Assn. Rept., 1863, p. 641. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 261.

Shell very small, ovate trigonal, inequilateral; posterior end evenly rounded; posterior dorsal margin rounded; in other ways resembles *P. tantilla.*

Dimensions.—Long. 5 mm.; alt. 4 mm.; diam. 2.5 mm.

Distinguishable from *P. tantilla* by smaller size and less trigonal outline. Specimens examined showed no coloration.

Rare in the lower San Pedro series at Deadman Island and San Pedro. Found also in the Pliocene at Packard's Hill, and in the Pleistocene at the bathhouse, Santa Barbara.

Living.—Catalina Island (Cooper; Arnold): 10 fathoms (Arnold, 1901).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara (Arnold).

Pliocene.—Santa Barbara (Arnold).

92. **Psephis tantilla** *Gould.*

PLATE XIII, FIG. 5.

Venus tantillus GLD., Bost. Jour. Nat. Hist., Vol. VI, 1853, p. 906, Pl. XV, fig. 10.
Trigonia tantilla GLD., CARPENTER, Proc. Zool. Soc., 1856, p. 201.
Psephis tantilla GLD., CARPENTER, Brit. Assn. Rept., 1863, p. 640; = *Venus rysonia* GABB (*fide* GABB. Pal. Cal., Vol. II, p. 96, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 261. KEEP, West Coast Shells, p. 186, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 188.

Shell small, ovate-trigonal, inequilateral; beaks acute, slightly anterior to center; surface smooth or faintly waved with distant, concentric furrows; the dorsal margins are nearly straight, and meet at the apex in a right angle, but the posterior side is a fourth longer than the anterior; the anterior basal angle is well rounded, while the posterior is acute; basal margin gently curved; hinge area short, wide; three prominent, elongated cardinal teeth in each valve.

Dimensions.—Long. 10 mm.; alt. 8 mm.; diam. 4.9 mm.

Somewhat resembles a very small *Tivela crassatelloides*. Some show original purple spot on posterior end. Specimens identified by Dr. Dall.

Rather common in the lower San Pedro series at Deadman Island and San Pedro; rarer in the upper San Pedro series at Deadman Island, Los Cerritos, and San Pedro. The specimen figured is from the lower San Pedro series at Deadman Island and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to Catalina Island (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Family XXVIII. COOPERELLIDÆ.

Genus **Cooperella** *Carpenter.*

Shell small, thin, smooth, or concentrically striate or undulate, equivalve, nearly equilateral, with entire margins; ligament long; resilium short; hinge plate narrow, carrying two right and three left subumbonal, divaricating, short cardinal teeth; laterals none; pallial line narrow, with an ample sinus.

Type, *Œdalia subdiaphana* (Carpenter).

93. **Cooperella subdiaphana** *Carpenter.*

PLATE XIII, FIG. 1.

Œdalia subdiaphana CPR., Brit. Assn. Rept., 1863, p. 639; Jour. de Conch., Vol. XII, 1865, p. 134.
Œdalina subdiaphana CPR., Proc. Cal. Acad. Sci., Vol. III, 1866, p, 208.
Cooperella subdiaphana CPR., DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1062.

Shell small, subquadrangular, subequilateral, convex, very thin and fragile; posterior extremity evenly rounded; anterior extremity rounded near base; surface smooth except for incremental lines; beaks slightly raised, sharp, prominent; two narrow, tall, sharp, bifid teeth in left valve, three in right; pallial sinus very large.

Dimensions.—Long. 12 mm.; alt. 9 mm.; diam. 6 mm.

Externally this species much resembles a *Kellia*, but may be distinguished by the pallial sinus and hinge teeth. Specimens identified by Dr. Dall.

Two left valves from lower San Pedro series of Deadman Island, one of which is figured, and is now in the collection of Delos Arnold. Rather common in the Pleistocene at Spanish Bight, San Diego.

Living.—Vancouver Island to Todos Santos Bay (Dall).

Pleistocene.—San Pedro (Dall; Arnold): San Diego (Arnold).

Family XXIX. PETRICOLIDÆ.

Genus **Petricola** *Lamarck*.

Shell oval or elongated, thin, tumid, anterior side short; hinge with generally three teeth in each valve, the external often obsolete; pallial sinus deep.

Type, *Venus lapicida* (Chemn.).

Section *Petricola Lamarck s. s.*

Shell ovate, with a short or moderately wide pallial sinus, the radial sculpture more or less divaricate or zigzag.

Type, *Petricola lapicida* (Gmel.).

94. **Petricola carditoides** *Conrad*.

Saxicava carditoides CON., Jour. Acad. Nat. Sci. Phil., Vol. VII, 1837, p. 255, Pl. XX, fig. 8.

Petricola carditoides CON., Jour. Acad. Nat. Sci. Phil., 1849, p. 213. CARPENTER, Proc. Zool. Soc., 1856, p. 214; =*P. californica* CON. =*P. cylindracea* DESH. =*P. arcuata* DESH. =*P. gibba* MIDD. (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 641). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 258. KEEP, West Coast Shells, p. 183, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 189. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 835; Part 5, 1900, p. 1059.

Shell of medium size and variable outline, generally oblong-oval, convex, thick; surface ornamented with fine, concentric, incremental lines, which sometimes form irregular ridges, and by fine, wavy, radiating lines; hinge-area prominent; three cardinal teeth in each valve, the anterior one smallest; margin smooth.

Dimensions.—Long. 28 mm.; alt. 25 mm.; diam. 16 mm.

A variable form which is recognized, however, by its sculpture, prominent teeth and thick shell. Often found in holes in the pebbles and boulders comprising the conglomerate in this formation. Specimens identified by Dr. Dall.

Not uncommon in the lower San Pedro series at Deadman Island; and in the upper San Pedro series at Deadman Island, Los Cerritos, Crawfish George's, and San Pedro. Found also in the Pleistocene at Spanish Bight, San Diego.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Section *Rupellaria Fleurian.*

Shell inflated and rounded in front, attenuated and more compressed behind; sculpture chiefly radial; stronger anteriorly.

Type, *Petricola lithophaga* (Retzius).

95. **Petricola (Rupellaria) lamellifera** *Conrad.*

Venus lamellifera CON., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 257, Pl. XIX, fig. 19.
Venerupis cordieri var. *B*, DESH., B. M. Catal. Ven., p. 191, No. 1.
Petricola cordieri DESH., Rev. Zool. Soc. Cur., 1839, p. 358; Mag. Zool., Pl. XVIII.
Rupellaria lamellifera CON., CARPENTER, Proc. Zool. Soc., 1856, p. 214. CARPENTER, Brit. Assn. Rept., 1863, p. 641. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 262. KEEP, West Coast Shells, p. 183, fig. 156, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 184.

Shell of medium size, convex, equivalve, inequilateral, thick; beaks anterior to middle, marginal, not much elevated, turned slightly forward; anterior extremity evenly rounded; posterior extremity widely truncated; surface sculptured by ten or twelve lamelliform, concentric, slightly reflected ribs, and rather faint radiating sulcations; lunule indistinct, sculptured; ligament rather short; hinge strong, with two bifid and one single tooth in each valve; pallial sinus deep, narrow, pointed; muscle-impressions distinct, oval.

Dimensions.—Long. 26 mm.; alt. 21.5 mm.; diam. 16 mm.

This species resembles *Petricola carditoides*, but is distinguishable by the prominent concentric lamellar frills. Like *P. carditoides* this shell bores in the rocks; and all of the specimens obtained were broken from the shale pebbles in the upper San Pedro gravels of Deadman Island.

Living.—Farallon Islands to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Section *Petricolaria Stoliczka.*

Shell elongated, pholadiform, thin; hinge-teeth protracted, slender; pallial sinus deep.

Type, *Petricola pholadiformis* (Lane).

96. **Petricola (Petricolaria) denticulata** *Sowerby.*

Petricola denticulata SBY., Thes. Conchyliorum (?).
Petricola pedroana CON., Pac. R. R. Rept., Vol. V, p. 324, Pl. III, fig. 24, 1856. GABB, Pal. Cal., Vol. II, p. 119, 1869.
Petricola denticulata SBY., CARPENTER, Brit. Assn. Rept., 1856, pp. 244, 297.
Cypricardia pedroana CON., COOPER, Bull. No. 4, Cal. St. Min. Bureau, 1894, p. 25.

Shell small, elongate-oval, convex, thin; surface sculptured by fine, concentric, incremental lines, and numerous, undulating, radiating ridges, which are most prominent on the anterior portion of the shell; anterior end short and rounded; teeth small; pallial sinus deep.

Dimensions.—Long. 20 mm.; alt. 12 mm.; diam. 10 mm.

Distinguishable from *P. carditoides* by its smaller size, narrower form, thinner shell, and coarser sculpture. Specimens of this same species in the State Museum collection at the University of California, Berkeley, are labeled *P. cognata* Adams. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island, and the upper San Pedro series at Los Cerritos and San Pedro.

Living.—Mazatlan to Peru (Carpenter).

Pleistocene.—San Pedro (Arnold; Blake.)

Pliocene (?).—Los Angeles City (Williamson).

97. **Petricola (Petricolaria) cognata** *C. B. Adams.*

Petricola cognata C. B. ADS., Cat. Panama Shells; Ann. N. Y. Lyc. Nat. Hist., Vol. V, 1852, p. 510. CPR., Brit. Assn. Rept., 1856, p. 363; Proc. Zool. Soc., 1863, p. 367.

Shell of medium size, much elongated, transverse, convex, thin, equivalve; beaks small, near anterior extremity, turned forward, slightly elevated; anterior extremity short, evenly, pointedly rounded; posterior extremity long, evenly, pointedly rounded; surface of shell, anterior to a line running obliquely backwards from the beaks, sculptured by ten or eleven prominent, narrow, squamosely spined, radiating ridges; surface posterior to this line ornamented by finer radiating lines; rather prominent incremental lines over the whole surface; hinge of left valve consists of a curved, saddle-shaped process of two teeth, one of which is bifid; hinge of right valve smaller and straighter with less prominent division of teeth.

Dimensions.—Long. 36 mm.; alt. 10.5 mm.; diam. 10 mm.; beaks to anterior extremity 6 mm.; to posterior extremity 30 mm.

The line of demarkation between the fine and prominent radiating sculpture in this species is not marked as in the *Pholadidea*. Distinguishable from *P. denticulata* by more prominent sculpture anteriorly, longer shell, more prominent hinge-teeth and more anterior beaks. *P. cognata* is close to the Atlantic *P. pholadiformis*. Some authorities, notably Carpenter, unite the two forms.

Rare in the upper San Pedro series at the lumber yard at San Pedro and at Deadman Island.

Living.—San Pedro to Panama (Dall, mss.).

Pleistocene.—San Pedro (Arnold).

Superfamily TELLINACEA.

Family XXX. TELLINIDÆ.

Genus **Tellina** *Linné.*

Subgenus **Mœrella** *Fischer.*

Shell small, compressed, hardly folded, acute behind, rounded in front, with feeble, concentric sculpture; left laterals obsolete; no interior radii; the sinus long, coalescent with the pallial line below.

Type, *Tellina donacina* (Linné).

98. Tellina (Mœrella) salmonea *Carpenter.*

PLATE XIII, FIG. 7.

Mœra salmonea CPR., Brit. Assn. Rept., 1863, p. 639; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. IV, 1864, p. 423. KEEP, West Coast Shells, p. 196, 1892.

Shell small, suboval, convex, equivalve, inequilateral, thin; umbones anterior to center, small, sharp; anterior extremity short, rounded; posterior dorsal margin straight; posterior extremity acutely rounded; ventral margin evenly arcuate; surface glossy, ornamented with fine, concentric, incremental lines, and obsolete radiating scratches; cardinal tooth small, bifid; no lateral teeth; pallial sinus long, broad; one faint, internal, submarginal, posterior, radiating ridge.

Dimensions.—Long. 11 mm.; alt. 8 mm.; diam 4.2 mm.; umbo to anterior extremity 3 mm.; to posterior extremity 8 mm.

Resembles *Donax*, but is much thinner, more evenly rounded anteriorly, has no lateral teeth, and is not crenulated on the interior of the margin. Specimen identified by Dr. Dall.

Not uncommon in the lower San Pedro series at Deadman Island, whence the specimen figured came. This specimen is now in the collection of Delos Arnold.

Living.—Vancouver to Monterey (Carpenter).

Pleistocene. San Pedro (Arnold).

Subgenus Angulus *Megerle.*

Shells elongated, generally small, compressed, with the posterior end angularly pointed and not twisted; the surface smooth or with fine concentric sculpture; nymphs short and prominent, the ligament short; hinge with a single adjacent lateral well developed in the right valve anteriorly; internally a thickened ray passes from the umbo just behind the anterior adductor scars, and one or two narrower similar rays in front of the posterior adductors; sinus largely coalescent with the pallial line below.

Type, *Tellina lanceolata* Linné.

99. Tellina (Angulus) buttoni *Dall.*

PLATE XVI, FIGS. 1 AND 2.

Tellina (Oudardia) buttoni DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1036, Pl. XLVII, fig. 18.

Angulus modestus of California collectors (not of CARPENTER).

Tellina (Angulus) var. *obtusus* CPR. (not *Tellina obtusa* SOWERBY.)

?*Tellina pedroana* CON., Pac. R. R. Rept., Vol. V, p. 323, Pl. III, fig. 17, 1855.

?*Macoma pedroana* CON., GABB, Pal. Cal., Vol. II, pp. 94, 124, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 248.

Shell small, oblong, subtriangular, compressed, thin; umbones slightly posterior to center; anterior dorsal margin evenly arcuate; anterior extremity quite acutely rounded, produced furthest near base; ventral line subrectilinear; posterior extremity cuneiform, abruptly truncated at end near base; surface sculptured by fine, concentric, incremental lines; one prominent cardinal tooth in each valve; one sharp, anterior lateral tooth in right valve; pallial sinus large, does not quite reach to anterior muscle-impression; anterior, radiating callus passes from umbo just posterior to the anterior muscle-impression.

Dimensions.—Long. 18 mm.; alt. 10.5 mm.; diam. 4 mm.; umbo to anterior extremity 11 mm.; to posterior extremity 7 mm.

A note accompanying one of these specimens says, "*Tellina striata* Hanley. This specimen was identified by Dr. Dall." Upon further examination Dr. Dall pronounced them to be *Angulus buttoni*.

Found in lower San Pedro series of Deadman Island and San Pedro bluffs; and in the upper San Pedro series of Deadman Island, San Pedro, Crawfish George's, and Los Cerritos. Found also in the Pleistocene at Barlow's ranch, Ventura. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—West Coast.

Pleistocene. San Pedro; Ventura (Arnold).

100. Tellina (Angulus) bodegensis *Hinds.*

PLATE XV, FIG. 8.

Tellina bodegensis HDS., Voy. Sulphur, p. 67, Pl. XXI, fig. 2, 1844. CARPENTER, Brit. Assn. Rept., 1863, p. 639; = *T. emacerata* CON. (*fide* GABB, Pal. Cal., Vol. II, p. 92, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 267. KEEP, West Coast Shells, p. 197, fig. 169, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1029.

Shell of medium size, elongated, narrow-ovate, rather thick; umbones posterior to center and pointing posteriorly; anterior portion of shell evenly rounded, the dorsal and ventral lines being nearly parallel; posterior dorsal margin depressed back of umbo, running off quite obliquely to a line which truncates the posterior end near the base; basal posterior angle nearly a right angle; basal line nearly straight; a prominent bifid cardinal tooth on each valve; pallial sinus long and narrow; generally thickened anteriorly.

Dimensions.—Long. 48 mm.; alt. 25 mm.; diam. 12 mm.; umbo to anterior extremity 27 mm.; to posterior extremity 21 mm.

Specimen identified by Dr. Dall.

Common in the upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, Deadman Island, and Long Beach; rarer in the lower San Pedro series at Deadman Island and San Pedro. Found also in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to San Diego; Japan (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Miocene.—Oregon; Walnut Creek, Contra Costa County (Cooper).

101. Tellina (Angulus) idæ *Dall.*

PLATE XV, FIG. 7.

Tellina idæ DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 183, Pl. VI., fig. 3; Pl. VII, figs. 1, 4. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185. COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 32.

Tellinella, COOPER, No. 63, Geol. Cat., 1867.

Shell of medium size, ovate-triangular, moderately elongate, compressed, thin; beaks subcentral, small, pointed, prominent; anterior extremity evenly rounded; posterior dorsal slope steeper, rectilinear, obliquely truncate at its termination; ventral margin moderately incurved at flexure, which is narrow, but well marked, and extends out into a prominent beak at the extremity of the shell; a prominent, narrow, submarginal, flexural ridge extends from beak to posterior extremity; surface sculptured with numerous, regular, sharp, elevated, concentric, incremental lines; hinge area broad and strong; one prominent cardinal tooth in each valve, which is bifid in right valve; one anterior lateral in right valve; ligamental area prominent, long; pallial sinus very large, extending nearly to anterior adductor scar.

Dimensions.—Long. 62 mm.; alt. 37 mm.; diam. 10 mm.

Distinguishable from *T. bodegensis* by larger, broader shell, more central, less curved beaks, much more prominent flexural ridge, posterior beak and incurved base line, much stronger, broader hinge, and much larger pallial sinus. Distinguishable from *T. rubescens* by more extended, beaked posterior extremity, flexural ridge, straight beaks, and much stronger hinge, especially in the ligamental area. Specimens identified by Dr. Dall.

One valve found in the upper San Pedro series at Los Cerritos, which is figured herewith, is now in the collection of Delos Arnold.

Living.—Catalina Island, 16 to 38 fathoms, young (Dall): San Pedro Bay; Long Beach (Shephard).

Pleistocene.—San Pedro (Arnold).

102. Tellina (Angulus) rubescens *Hanley.*

PLATE XV, FIG. 9.

Tellina rubescens HANL., CARPENTER, Brit. Assn. Rept., 1856, p. 302.

Shell of medium size, ovate-triangular, compressed, thin; beaks posterior, small, sharp, turned toward the rear; anterior dorsal margin evenly but slightly arcuate to near extremity, where it turns off quite abruptly, giving an evenly rounded end, which is most produced below the middle; posterior dorsal slope steeper, rectilinear; posterior extremity truncated, with a rounded right angle at base; basal margin nearly rectilinear from posterior angle to within one-third length of shell from anterior end; a prominent angular ridge extends from beak to posterior basal angle; surface sculptured by regular alternating concentric bands and distinct sulcations; sculpture less regular posterior to angular ridge; hinge-area small; right valve with two cardinal teeth, posterior one bifid; one posterior lateral tooth at lower end of ligamental area in right valve; pallial sinus large, arcuate upwards near middle and extending nearly to anterior adductor scar.

Dimensions.—Long. 43 mm.; alt. 26 mm.; diam. 10 mm.; beak to anterior extremity 23 mm.; to posterior extremity 20 mm.

Distinguishable from *T. bodegensis* by much broader shell, less oblique truncations, greater convexity, more regular and coarser sculpture, stronger hinge, posterior lateral tooth, and much larger pallial sinus, which extends almost to anterior adductor. Distinguishable from *T. idæ* by less produced and unflexed posterior portion, basal posterior angle, and rectilinear ventral margin, weaker hinge, and posteriorly bent beaks. This species seems to lie between *T. idæ* and *T. bodegensis* in many respects, having the large sinus of the one and the general, though much broader, outline of the other. Specimen identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; one perfect right valve, which is figured, is now in the collection of Delos Arnold.

Living.—Panama; Central America (Carpenter).

Pleistocene.—San Pedro (Arnold).

Genus **Metis** *H. & A. Adams.*

Shell slightly inequivalve, suborbicular, compressed; valve sillonated; posterior flexuosity submedian; no lateral teeth.

Tellina meyeri Phil. is a characteristic species.

103. **Metis alta** *Conrad.*

Tellina alta CON., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 258; (not *T. alta* CON., Foss. Tert. Form., Vol. I, No. 4, p. 41, 1833. HANLEY, Thes. Conch., Vol. I, p. 332, Pl. LXII, fig. 200, 1847.

Lutricola alta CON., CARPENTER, Brit. Assn. Rept., 1863, p. 639; =*Arcopagia medialis* CON. (*fide* GABB, Pal. Cal., Vol. II, p. 92, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 247. KEEP, West Coast Shells, p. 197, 1892. WILLIAMSON, Proc. U.S. Nat. Mus., Vol. XV, 1892, p. 186.

Metis alta CON., =*Scrobicularia biangulata* CPR. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1044).

Shell large, suboval, approaching to subcircular, ventricose, of medium thickness; beaks central; anterior extremity obtusely rounded; posterior side of the deeper valve biangulated; the opposite valve with an angular groove; surface sculptured by numerous prominent lines of growth and by numerous minute, radiating lines; cartilage-pit more vertical than oblique; muscle-impressions large.

Dimensions.—Long. 75 mm.; alt. 65 mm.; diam. 40 mm.

Resembles a large, rounded, ventricose *Macoma*. Specimens identified by Dr. Dall.

Common in upper San Pedro series of San Pedro, and exceedingly so in the Pleistocene of Los Cerritos, where they occur in beautifully preserved pairs. A few specimens found in the upper San Pedro series at Deadman Island and Crawfish George's; and in the lower San Pedro series at Deadman Island. Found in the Pliocene at Pacific Beach, and in the Pleistocene at Spanish Bight, San Diego.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego (Arnold).

Pliocene.—Santa Barbara (Cooper): San Fernando (Cooper; Arnold): San Diego (Arnold).

Miocene.—Monterey; El Toro Ranch, Monterey County (Cooper).

Genus **Macoma** *Leach.*

Shell without lateral teeth, usually subtrigonal and with a marked posterior flexure; the surface feebly sculptured concentrically, or smooth; the siphons naked.

Type, *M. tenera* Leach.

Subgenus **Macoma** *s. s.*

Shell subtrigonal, the periostracum conspicuous; usually colorless, or, if colored, without color pattern; flexure well marked; the pallial sinus coalescent with the pallial line below, and often discrepant in the two valves; inhabiting the cooler seas, and especially boreal waters.

104. **Macoma calcarea** *Gmelin.*

PLATE XVI, FIG. 2.

Tellina calcarea, *teste ovata*, etc., CHEM., Conch. Cab., Vol. VI, p. 140, Pl. XIII, fig. 136, 1782.

Tellina calcarea, GMELIN, Syst. Nat., Ed. VI, p. 3236, No. 38, 1792.

Macoma calcarea CHEM. =*Sanguinolaria californica* CON. =*Tellina pedroana* CON. =*Tellina tenera* LEACH (*fide* GABB, Pal. Cal., Vol. II, p. 124, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 248.

Macoma calcarea GMELIN. =*Tellina lata* GMELIN. =*Tellina subulosa* SPENGLER. =*Macoma tenera* LEACH =*Tellina proxima* (BROWN) SBY. =*Tellina sordida* COUTHOUY. =*Sanguinolaria sordida* GLD. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900).

Shell of medium size, suboval, slightly convex, inequilateral, thin; anterior end shorter than posterior, with fold running from apex to lower anterior extremity, which is biangular; anterior dorsal margin straight; anterior end evenly rounded; beaks anterior to middle, small, inconspicuous; surface sculptured by fine incremental lines; two cardinal teeth on left valve, anterior one bifid; pallial sinus large.

Dimensions.—Long. 18.2 mm.; beak to anterior extremity 8.2 mm.; to posterior extremity 10 mm.; alt. 13.5 mm.; diam. 5.2 mm.

This species is distinguishable from *M. yoldiformis* by its more prominent fold and much broader form; distinguished from others of this genus found in these deposits by having the anterior (folded and angular) end shorter than the posterior end. Specimens identified by Dr. Dall. Specimens of this species are labeled "*M. expansa*" in the State Museum Collection, at the University of California, at Berkeley.

Several specimens from the lower San Pedro series and Pliocene of Deadman Island. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Arctic and boreal seas, south on Atlantic Coast to Long Island Sound, on Pacific Coast to Oregon and Northern Japan (Dall).

Pleistocene.—Scandinavia; Scotland; Greenland; Siberia; Alaska (Dall): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

105. **Macoma indentata** *Carpenter.*

PLATE XVI, FIG. 1.

Macoma indentata CPR., Brit. Assn. Rept., 1863, p. 639. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 248. KEEP, West Coast Shells, p. 195, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1052.

Shell of medium size, rather narrow, suboval, compressed, thin; umbones slightly posterior to center; anterior end long and evenly rounded; posterior dorsal line straight; ventral line near posterior end indented, the posterior extremity being much projected and sharply rounded; fold very prominent; ligamental area short, scooped out.

Dimensions.—Long. 50 mm.; alt. 32 mm.; diam. 14 mm.; umbo to anterior exremity 28 mm.; to posterior extremity 22 mm.

Resembles *M. nasuta* and *M. kelseyi*, but is distinguishable by its smaller shell, posterior umbones, indentation in ventral margin, more prominent fold and more prominently projected posterior extremity. Specimen identified by Dr. Dall.

Rare in the upper San Pedro series at Los Cerritos and San Pedro. Found in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at Los Cerritos, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper; Arnold).

Miocene.—El Toro Ranch, Monterey County; Griswold's, San Benito County (Cooper).

106. Macoma inquinata *Deshayes.*

PLATE XVI, FIG. 4.

Tellina inquinata DESH., Proc. Zool. Soc., 1854, p. 357.

Macoma inquinata DESH., CARPENTER, Brit. Assn. Rept., 1863, p. 689. GABB, Pal. Cal., Vol. II, p. 93, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 248. KEEP, West Coast Shells, p. 195, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1053.

Shell of medium size, suboval, convex, thin, equivalve; umbones subcentral; anterior end dilated, rather prominently so in front of umbo of right valve; posterior end evenly arcuate from umbo and acutely rounded at posterior end about half way between dorsal and ventral margins; ligament of medium length, not prominent; two small cardinal teeth in each valve; pallial sinus does not reach anterior muscle-impression in the left valve.

Dimensions.—Long. 35 mm.; alt. 27 mm.; diam. 15 mm.; umbo to anterior extremity 16 mm.; to posterior extremity 19 mm.

Distinguishable by medium size, short, equally convex valves, very faint or obsolete fold; evenly, acutely rounded, rather than truncated, posterior extremity, and disconnection of pallial sinus and anterior muscle-impression. Specimen identified by Dr. Dall.

Not uncommon in the Pliocene at Deadman Island, the lower San Pedro series at Deadman Island, and the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, and Crawfish George's. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Alaska to San Diego (Cooper).

Pleistocene.—Monterey to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—Twelve Mile House; San Fernando (Cooper).

107. Macoma nasuta *Conrad.*

PLATE XVI, FIG. 3.

Tellina nasuta CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 258.

Macoma nasuta CON. = *M. tersa* GLD., (*fide* CARPENTER, Brit. Assn. Rept., 1863, p. 639). GABB, Pal. Cal., Vol. II, p. 93, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 248. KEEP, West Coast Shells, p. 194, fig. 165, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1053.

Shell of medium size, ovate, compressed, thin; anterior side dilated; posterior side cuneiform, extremity truncated much above the line of the base; posterior dorsal margin straight to angle where it joins line of truncation; fold carinated on the right valve; umbones slightly anterior to center, slightly prominent; two prominent narrow cardinal teeth in each valve; no laterals; ligament external, long, straight, narrow; pallial sinus large, expanding interiorly, that of the left valve joining anterior muscle-impression at its lower posterior angle.

Dimensions.—Long. 76 mm.; alt. 54 mm.; diam. 23 mm.; umbo to anterior end 31 mm.; to posterior end 45 mm.

Distinguishable from *M. secta* by smaller size, less convex valves, less altitude, longer, straight posterior margin, and longer, less prominent ligamental callus; from *M. inquinata* by larger, longer shell, less convex valves, less relative altitude, straight dorsal margin with truncation posteriorly, and by less central umbones; from *M. yoldiformis* by more cuneiform posterior extremity, long, straight posterior dorsal margin, and by having the beaks anterior to center rather than posterior; from *M. identata* by beaks being more anterior, being broader, and by lacking the prominent folds, indentation of ventral margin, and prominent projection of posterior extremity; from *M. kelseyi*, which closely resembles it, by broader shell, and more oblique truncation of posterior extremity. Specimens identified by Dr. Dall.

Rather common in the lower San Pedro series at Deadman Island and San Pedro, and the upper San Pedro series at Los Cerritos, Long Beach, Crawfish George's, Deadman Island, and San Pedro. The upper San Pedro strata afford larger specimens, as a rule, than those found in the lower San Pedro.

Found also in the Pliocene at Pacific Beach, and in the Pleistocene at Spanish Bight and Pacific Beach, San Diego, and in the Pleistocene at Barlow's ranch, and the old ditch, Ventura.

The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Alaska to San Diego; Kamtschatka (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—Eagle Prairie and Danger Creek, Humboldt County; Santa Rosa; San Fernando (Cooper): San Diego (Arnold).

Miocene.—Sunol, Alameda County; Foxin's, Santa Barbara County (Cooper).

108. **Macoma nasuta** *Conrad* var. **kelseyi** *Dall.*

Macoma kelseyi DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1052, Pl. XLIX, fig. 7.

Shell of medium size, elongate-ovate, compressed, thin; posterior extremity cuneiform, obliquely truncated much above ventral margin; umbones nearly central; other characteristics same as in *M. nasuta.*

Dimensions.—Long. 70 mm.; alt. 45 mm.; diam. 18 mm.; umbo to anterior end 31 mm.; to posterior end 39 mm.

Distinguishable from other species by same characteristics that distinguish *M. nasuta;* distinguished from *M. nasuta* by narrower, flatter shell, and more oblique truncation of posterior end. Specimens identified by Dr. Dall.

Rare in the upper San Pedro series at San Pedro and Los Cerritos. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—San Diego and south (Dall).

Pleistocene.—San Pedro; San Diego (Arnold).

109. **Macoma secta** *Conrad.*

PLATE XVI, FIG. 5.

Tellina secta CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 257. HANLEY, Thes. Conch., p. 337, Pl. LXV, figs. 245, 248, 1847.

Macoma secta CON., CARPENTER, Brit. Assn. Rept., 1863, p. 639. H. & A. ADAMS, Gen. Rec. Moll., p. 401, 1858. =*Tellina ligamentina* DESH. (*fide* GABB, Pal. Cal., Vol. II, p. 73, 1869). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 249. KEEP, West Coast Shells, p. 191, fig. 163, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185.

Macoma (*Rexithærus*) *secta* CON. =var. *edulis* (NUTT. mss.) CPR. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1053).

Shell large, suboval, slightly ventricose, rather thin; umbones subcentral, evenly rounded anteriorly; posterior end truncated obliquely much above the base line; posterior dorsal margins short, straight, sloping off quite steeply to angle where it meets line of truncation; fold prominent; surface sculptured by lines of growth; two cardinal teeth in each valve; ligament short, thick, inserted on an elongated, oblique, rib-like callus; margin beneath the gape appearing as if cut or broken; pallial sinus large, expanded within, not reaching to anterior muscle-impression.

Dimensions.—Long. 82 mm.; alt. 65 mm.; diam. 24 mm.

Distinguishable by large size, broad shell, subcentral umbones, equal convexity of valves, and the prominent short ligamental callus. Resembles a *Mactra* somewhat in outline. Specimens identified by Dr. Dall.

Found in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at Deadman Island, Los Cerritos, Crawfish George's, San Pedro, and Long Beach. Found also in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Bodega Bay to San Diego; Japan (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—Santa Barbara; San Fernando (Cooper).

110. **Macoma yoldiformis** *Carpenter.*

PLATE XVI, FIG. 6.

Macoma yoldiformis CPR., Brit. Assn. Rept. 1863, p. 639. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 249. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 1053.

Shell small, subelliptical, compressed, very thin and fragile; umbones slightly posterior to center; anterior end evenly rounded, longer than posterior side, which is very faintly folded, biangular and more cuneiform; surface smooth, except for very fine incremental lines; ligamental area scooped out about one-half length of posterior end; teeth very small.

Dimensions.—Long. 23 mm.; alt. 13.2 mm.; diam. 6 mm.; umbo to anterior extremity 13 mm.; to posterior extremity 10 mm.

This species is distinguishable from other members of the genus by its small size, subelliptical form, very thin, smooth shell, posterior umbones and faint fold; distinguishable from *Tellina bodegensis* by less cuneiform posterior end and smaller size. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island. Rather common in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from this locality, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to San Pedro (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego (Arnold).

Family XXXI. SEMELIDÆ.

Genus **Semele** *Schumacher.*

Shell rounded, subequilateral, beaks turned forwards; posterior side slightly folded; hinge teeth two in right valve and two in left; laterals elongated, distinct in the right valve; external ligament short, cartilage internal, long, oblique; pallial sinus deep, rounded.

Type, *Tellina reticulata* Spengler.

111. **Semele decisa** *Conrad.*

Amphidesma decisa CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 234, Pl. XIX, fig. 2.

Semele decisa CON., CARPENTER, Proc. Zool. Soc., 1856, p. 213. CARPENTER, Brit. Assn. Rept., 1863, p. 640. GABB, Pal. Cal., Vol. II, p. 94, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. KEEP, West Coast Shells, p. 190, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 186. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 995.

Shell rounded, subequilateral, thick; beaks elevated, turned forward; posterior side shorter than the anterior, direct, biangulated; fold distinct; anterior end evenly rounded; anterior dorsal margin slightly depressed; surface with numerous, thick, concentric, rugose, slightly prominent ribs; cartilage-process oblique; cardinal teeth obsolete; lateral teeth distinct; pallial sinus wide and shallow.

Dimensions.—Long. 8.5 mm.; alt. 78 mm.; diam. 34 mm.

The specimen described is a large one. These shells are often found in pairs in these deposits. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at San Pedro; common in the upper San Pedro series at Los Cerritos, but rarer in the same horizon at Deadman Island and San Pedro. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego (Arnold).

112. Semele pulchra *Sowerby.*

PLATE XV, FIGS. 1 AND 1*a*.

Amphidesma pulchra SBY., Conch., Vol. III, No. 2, fig. 2.

Semele pulchra SBY., CARPENTER, Brit. Assn. Rept., 1863, p. 640. GABB, Pal. Cal., Vol. II, p. 94, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. KEEP, West Coast Shells, p. 190, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 186. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 995.

Shell small, oval, thin; beaks turned forward; posterior sides shorter than the anterior, slightly biangular; fold not very distinct; anterior dorsal margin slightly convex; anterior end evenly rounded; surface sculptured with numerous fine, sharp concentric ridges, and fine radiating striations; interior as in *S. decisa* except more delicate, and cardinal tooth in each valve prominent.

Dimensions.—Long. 22 mm.; alt. 18.2 mm.; diam. 6 mm.

Distinguishable from *S. decisa* by smaller, thinner shell, finer concentric sculpture and radiating striations. Specimens of the species in the State Museum Collection at the University of California, Berkeley, are labeled *S. flavescens* Gld. Specimens identified by Dr. Dall.

Rather rare in the upper San Pedro series at San Pedro and Los Cerritos. Found also in the Pleistocene at Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego; Acapulco to South America (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego (Cooper; Arnold).

113. Semele pulchra *Sowerby*, montereyi, var. nov.

PLATE XV, FIGS. 4 AND 4*a*.

Shell small, oval, ventricose, thin; beaks quite posterior to middle of shell; anterior dorsal margin long, nearly straight; anterior extremity evenly curved; posterior end much shorter than anterior, evenly rounded; fold obsolete; cartilage-process deep, oblique; one prominent cardinal tooth in each valve; lateral teeth distinct; pallial sinus very large, rounded, expanded interiorly.

Dimensions.—Long. 23 mm.; alt. 17.5 mm.; diam. 11.5 mm.

Resembles *S. pulchra* in size, but is much more oval, lacking the angular appearance at the beak; the beaks are situated more anteriorly in var. *montereyi* and the shell is much more ventricose. Easily differentiated from the typical *S. pulchra*. Pronounced a new variety of *pulchra* by Dr. Dall.

Rare in lower San Pedro series at Deadman Island.

The specimen figured is not the type, which is larger, and is in the United States National Museum. The specimen figured came from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Monterey (Dall).

Pleistocene.—San Pedro (Arnold).

Genus **Cumingia** *Sowerby.*

Shell transversely oval, equivalve, rounded in front, subrostrated and slightly gaping behind; small, thin, often irregular in form; hinge with a spoon-shaped cartilage-pit, and a small anterior cardinal tooth in each valve; two elongated lateral teeth in the right valve, less developed in the left; beaks small; surface concentrically ridged; pallial sinus very wide.

Type, *Cumingia mutica* Sowerby.

114. **Cumingia californica** *Conrad.*

Cumingia californica CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 234, Pl. XVII, fig. 12. CARPENTER, Brit. Assn. Rept., 1863, p. 640. GABB, Pal. Cal., Vol. II, 1869, p. 94. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238. KEEP, West Coast Shells, p. 196, fig. 168, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 186. =*C. similis* A. AD. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, part 5, 1900, p. 1001).

Shell of medium size, transversely oval, slightly ventricose, thin; umbones small, inconspicuous; anterior margin evenly rounded; posterior sloping from umbo at an angle of about 45 degrees, straight; posterior end somewhat obliquely truncated; surface sculptured by numerous, about equidistant, sharp, narrow, concentric ridges or frills; hinge with a triangular, spoon-shaped cartilage-pit and a small anterior cardinal tooth in each valve; two elongated lateral teeth in right valve, less developed in the left; pallial sinus very wide, expanded interiorly and deep.

Dimensions.—Long. 24.5 mm.; alt. 18 mm.; diam. 4.9 mm.

Resembles *Macoma nasuta* in general outline, but is easily distinguishable by the sharp, concentric ridges. Specimens identified by Dr. Dall.

Found in the lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at Deadman Island, Crawfish George's, and San Pedro.

Living.—Monterey to San Diego; Mazatlan (Cooper): Japan (Stimson).

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro (Arnold).

Family XXXII. PSAMMOBIIDÆ.

Genus **Psammobia** *(Lamarck) Bowdich.*

Subgenus **Psammobia** *s. s.*

Shell elongated, more or less pointed behind; compressed; somewhat rudely concentrically sculptured; the posterior dorsal area frequently sculptured diversely from the disc; the pallial sinus elongated and for the most part coalescent below with the pallial line.

Type, *Psammobia feroënsis* Gmel.

115. **Psammobia (Psammobia) edentula** *Gabb.*

Siliquaria edentula GABB, Pal. Cal., Vol. II, p. 53, Pl. XV, fig. 11, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 264.

Psammobia edentula GABB, DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 976.

Shell large, elongated, subelliptical, flattened, thin; beaks minute, posterior to middle; surface marked by distinct lines of growth most prominent near the margin; cardinal margins straight, sloping gently toward the ends; anterior end convexly and very obliquely subtruncate above, produced and rounded below; posterior end broadly and regularly rounded, a little less prominent below than above the middle; basal margin nearly straight; ligamental area long, projecting prominently beyond the cardinal line for nearly half the length of the anterior portion of the shell; projected area with large groove on outside, flat on inside; two prominent cardinal teeth, anterior less prominent and oblique; anterior muscle-impression large, subcircular; posterior smaller, subelliptical; pallial sinus deep and wide.

Dimensions.—Long. 135 mm.; alt. 69 mm.; diam. 13 mm.

This fine shell was originally described by Gabb from a specimen obtained in the Pliocene of San Fernando. On account of the matrix in which his specimen was imbedded, the hinge area and interior were only partly accessible, hence it was deemed expedient to more fully describe the interior of the shell. Dr. Dall pronounced the shell described above a member of the genus *Psammobia*. The cardinal teeth, however, are rather large for one of this genus.

Rare in the upper San Pedro series of San Pedro; three good specimens obtained.

Living.—?

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Fernando (Cooper).

Genus **Sanguinolaria** *Lamarck.*

Section *Nuttallia Dall.*

Shell large, suborbicular, inequivalve, more or less twisted, the right valve slightly flatter; the posterior cardinal in the left valve obsolete; the pallial sinus narrow in front and somewhat detached from the pallial line.

Type, *Sanguinolaria nuttalli* Conrad.

116. **Sanguinolaria (Nuttallia) nuttalli** *Conrad.*

Sanguinolaria nuttalli CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 230, Pl. XVII, fig. 6. CARPENTER, Brit. Assn. Rept., 1863, p. 638. KEEP, West Coast Shells, p. 198, fig. 170, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 979.

Shell large, subovate, thin; right valve ventricose, left compressed; umbones small, distant from anterior margin, slightly prominent, acute; surface smooth, except for fine incremental lines; anterior dorsal margin sloping concavely; posterior end evenly rounded from beaks; anterior end more sharply rounded and much more produced; ventral margin evenly curved; cardinal teeth prominent, fragile; ligamental area prominently projecting beyond cardinal line.

Dimensions.—Long. 80 mm.; alt. 59 mm.; diam. 23 mm.

Distinguishable from *Macoma* by the prominent ligamental projection, hinge, and less angular aspect. Specimens identified by Dr. Dall.

Rather rare in the upper San Pedro series at San Pedro and Los Cerritos.

Living.—Santa Barbara to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

Genus **Tagelus** *Gray.*

Beaks median or subposterior; teeth two in each valve, simple, pedunculate; valves without constriction or clavicle, straight; pallial sinus deep, reaching to or beyond the beaks; posterior adductor scar rounded; pallial sinus with the ventral part partially coalescent with the pallial line.

Type, *Solen gibbus* Spengler.

117. **Tagelus californianus** *Conrad.*

Solecurtus californianus CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 233, Pl. XVIII, fig. 3. CARPENTER, Brit. Assn. Rept., 1863, p. 638. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 265. Keep, West Coast Shells, p. 201, fig. 172, 1892.

Tagelus californianus CON., DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 184. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 984.

Shell of medium size, oblong-oval, convex, thin; umbones about central; posterior dorsal margin runs straight back from umbo parallel with base; anterior dorsal margin slightly depressed, beginning a little below and in front of umbo, parallel with base; extremities evenly rounded; basal margin slightly contracted in middle; ligamental area slightly projecting; cardinal teeth, two in each valve, sharp and thin; pallial sinus long and wide, pointed.

Dimensions.—Long. 80 mm.; alt. 22 mm.; diam. 13 mm.

Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island and San Pedro; common in the upper San Pedro series at Deadman Island, Los Cerritos, Crawfish George's, San Pedro, and Long Beach. Also found in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—Santa Barbara; San Pedro; San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Diego (Dall).

Family XXXIII. DONACIDÆ.

Genus **Donax** *(Linné) Lamarck.*

Shell elongate, smooth, with no posterior carination; ventral margins with obsolete serration; cardinal teeth two in each valve, the larger often bifid; laterals both in the left valve, the anterior hardly distinguishable from the margin, of which it is a sort of modification.

Donax trunculus Linné is a characteristic species.

118. Donax californica *Conrad.*

PLATE XIII, FIG. 9.

Donax californica CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 254, Pl. XIX, fig. 21; (not of CARPENTER, Brit. Assn. Rept., 1863, p. 640.); (not of COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238); (not of KEEP, West Coast Shells, p. 192, fig. 164, 1892); (not of WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 186). = *D. navicula* HANLEY (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 968).

Donax flexuosus (not of GOULD, Bost. Jour. Nat. Hist., Vol. VI, 1857, p. 394, Pl. XV, fig. 8); (not of CPR., Brit. Assn. Rept., 1863, p. 640). ? COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238. KEEP, West Coast Shells, p. 192, 1892. ? WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 186.

Shell small, elongate-oval, rather pointed at both ends, thin; anterior end produced, quite sharply rounded; posterior portion over one-half length of anterior, rounded end; surface obscurely sculptured with fine radiating furrows; concentric, incremental sculpture sometimes visible; hinge and teeth as in *D. lævigata* except more delicate; interior of margin finely crenulated.

Dimensions.—Long. 18 mm.; anterior portion 11 mm.; posterior 7 mm.; alt. 8 mm.; diam. 6 mm.

Distinguishable from *D. lævigata* by smaller, narrower, thinner shell, more elongated posterior portion and much less steeply sloping dorsal margin on this end. This is the true *D. californica* Conrad, and not the *californicus* of Carpenter and other later writers (see synonymy above). Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at San Pedro. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold).

119. Donax lævigata *Deshayes.*

PLATE XIII, FIG. 8.

Donax lævigata DESHAYES, Proc. Zool. Soc., 1854, p. 352. REEVE, Conch. Icon., Vol. VIII, Pl. V, fig. 31. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 969.

Donax californicus (not of CONRAD, Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 254, Pl. XIX, fig. 21). CARPENTER, Brit. Assn. Rept., 1863, p. 640. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238. KEEP, West Coast Shells, 192, fig. 164, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 186.

Donax obesus, GLD., Proc. Bost. Soc. Nat. Hist., Vol. IV, 1851, p. 90; Bost. Jour. Nat. Hist., Vol. VI, p. 394, Pl. XV, fig. 9, 1857.

Shell rather small, trigonal, convex, wedge-like, closed; anterior portion produced, rounded, upper margin straight; posterior portion very short and dorsal margin nearly straight, also angulated at base; surface obscurely sculptured by fine radiating lines; incremental sculpture generally visible; interior of margin strongly crenulated; hinge teeth two in each valve; laterals one anterior and one posterior in each valve; pallial sinus deep.

Dimensions.—Long. 20.5 mm.; anterior portion 14 mm.; posterior 6.5 mm.; alt. 12 mm.; diam. 8 mm.

This is the common *Donax* of the West Coast, and is easily recognized by its triangular shape and the short, straight, posterior end. This species has been erroneously called *californicus* by Carpenter and others since then, but a comparison of one of these shells with Conrad's original figure and description of *californica* readily shows the error. The true *californica* Conrad has a rather produced and rounded posterior end, and is much narrower than *lævigata*. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at San Pedro and Deadman Island; common in the upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, Long Beach, and Deadman Island. Found also in the Pleistocene at Barlow's ranch, Ventura; and at Spanish Bight, Twenty-sixth Street, and Pacific Beach, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Monterey?; San Luis Obispo to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego; Ventura (Arnold).

Superfamily SOLENACEA.

Family XXXIV. SOLENIDÆ.

Genus **Solen** *Linné.*

Hinge with one cardinal in each valve; beaks nearly anterior; external surface polished; valves usually straight.

Type, *Solen marginatus* Pulteney.

120. **Solen rosaceus** *Carpenter.*

Solen (*sicarius* ? var.) *rosaceus* Cpr., Brit. Assn. Rept., 1863, p. 638; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 177.

Solen rosaceus Cpr., Gabb, Pal. Cal., Vol. II, p. 88, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888. p. 265. Keep, West Coast Shells, p. 202, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 184. Dall, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 952.

Shell of medium size, long, subcylindrical, slightly falcate, margins parallel, ends gaping; beaks terminal; anterior extremity evenly rounded, projecting furthest a little below the middle; posterior extremity very long, evenly rounded; hinge-teeth, one in each valve; ligament long, external; anterior muscle-impressions elongated; posterior oblong; sinus with squarish corners.

Dimensions.—Long. 55 mm.; alt. 10.5 mm.; diam. 6 mm.

This species much resembles *S. sicarius* but is much longer and narrower, more cylindrical, and has a much more evenly rounded and less abruptly truncated anterior extremity. Found also in the Pleistocene at Spanish Bight, San Diego.

Living.—Santa Barbara south to Gulf of California (Dall).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold): San Diego (Dall; Arnold).

Pliocene.—Santa Rosa; San Ramon, Kirker's Pass, Contra Costa County; San Fernando; San Diego well (Cooper).

Miocene.—Tomales, Marin County; Martinez, Contra Costa County (Cooper).

121. **Solen sicarius** *Gould.*

Solen sicarius GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1850, p. 214; Wilkes' Expl. Exped., Vol. XII, p. 287, fig. 501, 1852. CARPENTER, Brit. Assn. Rept., 1863, p. 638. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 265. KEEP, West Coast Shells, p. 202, fig. 173, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 184. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 952.

Shell of medium size, elongated, transversely oblong, cylindrical, slightly falcate; beaks terminal; anterior extremity truncate obliquely at angle of about 30 degrees, somewhat everted, the portion posterior to a line across from the beak to the base, concave; posterior extremity rounded; dorsal edge rectilinear; ventral edge regularly arcuate; surface undulated by lines of growth; hinge with single, erect, recurved, triangular tooth in each valve.

Dimensions.—Long. 63 mm.; alt. 16 mm.; diam. 9 mm.

Distinguishable by its terminal beak and rather falcate outline. Specimens identified by Dr. Dall.

Rather rare in the Pleistocene at Deadman Island and Timm's Point; common in the lower San Pedro series at Deadman Island and San Pedro; rare in the upper San Pedro series at Los Cerritos, San Pedro, Crawfish George's, and Deadman Island.

Living.—Straits of Fuca to San Pedro; Japan (Cooper).

Pleistocene.—San Pedro (Arnold).

Pliocene.—Twelve Mile Creek, San Mateo County; San Fernando (Cooper).

Miocene.—Walnut Creek, Contra Costa County (Cooper).

Genus **Siliqua** *Megerle.*

Shell smooth, oblong; epidermis polished; an umbonal rib extending across the interior of the valve; pallial sinus short.

Type, *Solen radius* Linné.

122. **Siliqua lucida** *Conrad.*

Solecurtus lucida CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 232, Pl. XVII, fig. 9; = *S. radiata* LINN. (*fide* CONRAD, Jour. Phil. Acad. Sci., 1849, p. 214). DALL, Solenidæ, Proc. U. S. Nat. Mus., Vol. XXII, 1900, p. 109.

Siliqua lucida CON., DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 957.

Shell of medium size, oblong-oval, compressed, thin, fragile; umbo a little less than one-fourth length from posterior end; interior raised callus sharp, narrow, perpendicular to dorsal margin; other characteristics the same as in var. *nuttalli.*

Dimensions.—Long. 32 mm.; alt. 12 mm.; diam. 5 mm.; umbo to anterior end 25 mm.; to posterior end 7 mm.

This species is distinguishable from var. *nuttalli* by its small size, fragile shell, more posterior umbo, and sharper, narrower, shorter, and more nearly perpendicular interior callus. Dr. Dall in his paper on the Solenidæ says that Carpenter (Brit. Assn. Rept., 1863, p. 634) and Gabb (1868) have confounded the young of *S. nuttalli* with this species. A large series of *S. lucida* from the Pleistocene shows the above mentioned differentiating characteristics to be constant. Specimens identified by Dr. Dall.

Rather rare in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at San Pedro and Los Cerritos. Found also in the Pleistocene at Twenty-sixth Street and Spanish Bight, San Diego.

Living.—Monterey to San Diego (Dall).

Pleistocene.—San Pedro; San Diego (Arnold).

123. **Siliqua patula** (*Dixon*) var. **nuttalli** *Conrad.*

Solecurtus nuttalli CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, page 232, Pl. XVII, fig. 9.

Machæra patula, not of DIXON, Voy. Around the World, p. 335, fig. 2, 1789. CARPENTER, Brit. Assn. Rept., 1863, p. 638 (in part). GABB, Pal. Cal., Vol. II, p. 89, 1869 (in part). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 248 (in part). ? KEEP, West Coast Shells, p. 201, fig. 171, 1892.

? Siliqua patula DIXON, WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 185.

Siliqua nuttalli CON., = *S. californica* CON. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 5, 1900, p. 956).

Shell large, oblong-oval, compressed, thin, fragile; umbones a little over one-fourth length from posterior end, minute; anterior end more acutely rounded than posterior; ligamental area prominent, projecting beyond an equally long depression in the anterior dorsal margin; cardinal teeth in right valve, four in the left; a strong, elevated callus extends over half way across the interior of the shell from the umbo at nearly right angles with the dorsal margin.

Dimensions.—Long. 101 mm.; alt. 39 mm.; diam. 14 mm.

Distinguishable from *S. lucida* by larger, heavier shell; distinguished from *Tagelus californianus* by the posterior position of the beaks, and by the more rounded extremities. Specimens identified by Dr. Dall.

Rare; a nearly perfect pair from the upper San Pedro series at San Pedro. Found also in the Pleistocene at Spanish Bight, San Diego.

Living.—Mouth of the Columbia River (Conrad).

Pleistocene.—San Pedro; San Diego (Arnold).

Pliocene.—? Localities.

Miocene.—? Localities.

Superfamily MACTRACEA.

Family XXXV. MACTRIDÆ.

Subfamily *MACTRINÆ.*

Genus Mactra *Linné.*

Shell nearly equilateral; anterior hinge-tooth A-shaped, with sometimes a small laminar tooth close to it; lateral tooth doubled in the right valve; ligament set off by a shelly lamina rising between chondrophore and ligament; cardinals generally coalescent above; laterals smooth or finely granular.

Type, *Mactra stultorum* Linné.

124. Mactra californica *Conrad.*

PLATE XIX, FIG. 2.

Mactra californica CON., Jour. Phil. Acad. Sci., Vol. VII, 1837, p. 240, Pl. XVIII, fig 12.· WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 187. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 876.

Standella californica CON., CARPENTER, Brit. Assn. Rept., 1863, p. 640. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 265. KEEP, West Coast Shells, p. 190, 1892.

Shell of medium size, subtrigonal, subequilateral, compressed, thick; umbones subcentral, turned anteriorly, margin only slightly arcuate; posterior side with a narrow, submarginal fold; posterior extremity quite sharply rounded; anterior dorsal line slightly depressed in front of umbones; anterior extremity evenly rounded; ventral margin evenly arcuate; surface sculptured with fine concentric lines; cartilage pit triangular, deep, separated from posterior ligamental groove by a ridge; cardinal teeth sharp, narrow, prominent; anterior ligamental groove long, narrow, with prominent interior margin; pallial sinus rather deep, rounded, not coinciding with ventral line.

Dimensions.—Long. 38 mm.; alt. 26 mm.; diam. 14 mm.; umbones to anterior extremity 17 mm.; to posterior extremity 21 mm.

The shell described was a small left valve, the only one so far obtained in the San Pedro Pleistocene. This species closely resembles *Spisula falcata*, but may be distinguished from that species by its thicker shell, more obtusely rounded anterior end, which gives it a less trigonal outline, and by the ridge which separates the posterior ligamental groove from the cartilage pit. Distinguishable from other species occurring in these beds by its almost central umbo, which turns slightly toward the front. Several specimens of the young of this species show prominent concentric undulations, reminding one somewhat of a small *Ræta undulata.*

Specimens identified by Dr. Dall. (Cooper makes *M. californica* and *M. planulata* synonymous, and under this heading reports the species from several localities in the Pleistocene, Pliocene and Miocene; but until his two forms are differentiated it would be useless to give his localities.)

Rare in upper San Pedro series of San Pedro; one specimen found, which is figured, and is now in the collection of Delos Arnold. Common in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—San Francisco to San Diego (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

125. **Mactra exoleta** *Gray.*

PLATE XIX, FIG. 4.

Mactra exoleta GRAY, = *Lutraria ventricosa* GLD. (*fide* CARPENTER, Proc. Zool. Soc., 1856, p. 200).

Shell of medium size, decidedly trigonal, ventricose, thin, fragile; umbones slightly anterior to center, elevated, not touching, turned only slightly forward; anterior dorsal margin straight; anterior extremity evenly rounded near base; ventral margin evenly arcuate; posterior dorsal margin arcuate, making an acute angle with the ventral margin; a sharp, prominent, angular ridge runs from umbo to the posterior extremity; surface sculptured with fine, incremental lines, which are most prominent posterior to ridge; cartilage-pit deep; hinge-teeth lamellar, long; ligamental groove very deep and narrow.

Dimensions.—Long. 56 mm.; alt. 43 mm.; diam. 30 mm.; umbo to anterior extremity 23 mm.; to posterior extremity 33 mm.

Distinguishable from others of genus by the sharply angular trigonal shape, great convexity, elevated umbo, and sharp, submarginal posterior ridge. Specimen identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; one nearly perfect right valve, which is figured, and is now in the collection of Delos Arnold. Found also in the Pleistocene at Spanish Bight and Pacific Beach, San Diego.

Living.—Coast of Mexico (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

126. **Mactra hemphilli** *Dall.*

PLATE XIX, FIG. 3.

Mactra hemphilli DALL, Nautilus, Vol. VII, 1894, p. 137, Pl. V.

Shell large, subtrigonal, subequilateral, convex, rather thin; umbones slightly elevated, subcentral, turned slightly forward; anterior portion hollowed in front of umbo, making the dorsal margin slightly concave; anterior end evenly rounded; posterior dorsal margin evenly arcuate, making a shorter turn into the ventral margin than does the anterior dorsal margin; posterior end most produced near base; a prominent angular submarginal fold runs from the umbo to the posterior extremity; hinge same as in *M. californica*, except that the anterior ligamental groove is much shorter; pallial sinus of medium size, very oblique.

Dimensions.—Long. 123 mm.; alt. 100 mm.; diam. 62 mm.; umbo to anterior extremity 50 mm.; to posterior extremity 73 mm.

This species is distinguishable from *M. californica* by its greater altitude, more concave anterior dorsal margin, shorter anterior ligamental groove, and oblique pallial sinus; one of its unique characteristics being the oblique sinus. Specimen identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; one specimen, which is figured, and is now in the collection of Delos Arnold.

Pleistocene.—San Pedro (Arnold).

Subgenus **Spisula** *Gray.*

Mactræ with ligament sagittate, set in a callous area close to the dorsal margin, and not set off from the chondrophore by any shelly ridge.

Type, *Mactra solida* (Linn.) Gray.

127. Mactra (Spisula) catilliformis *Conrad.*

PLATE XIX, FIG. 5.

Shell large, subtrigonal, slightly ventricose, rather thin; umbones slightly anterior to center, marginal, not prominent; a long, rather narrow, hollowed submarginal space in front of umbo; anterior dorsal margin straight; anterior extremity evenly rounded near middle of shell; posterior margin sharp, nearly straight; posterior extremity more obtusely rounded than anterior; ventral margin prominently and evenly arcuate; surface sculptured with fine incremental lines; posterior submarginal fold very faint; cartilage-pit large, triangular, very prominent; cardinal teeth not prominent; laterals narrow, short; anterior ligamental area not separated from cartilage-pit; pallial sinus horizontal, rather broad and shallow.

Dimensions.—Long. 125 mm.; alt. 98 mm.; diam. 54 mm.; umbo to anterior extremity 50 mm.; to posterior extremity 75 mm.

Distinguishable by its large size, broad, almost oval outline, prominent cartilage pit, long, depressed area in front of umbo, and nearly equally rounded ends. Specimen identified by Dr. Dall.

Rather common in the upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, and Deadman Island. Found also in the Pliocene at Pacific Beach, and in the Pleistocene at Pacific Beach, Spanish Bight and Twenty-sixth Street, San Diego; and in the Pleistocene at Barlow's ranch, Ventura. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—West Coast.

Pleistocene.—San Pedro; San Diego; Ventura (Arnold).

Pliocene.—San Diego (Arnold).

128. Mactra (Spisula) falcata *Gould.*

PLATE XIX, FIG. 1.

Mactra falcata GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1850, p. 216; Wilkes' Expl. Exped., Vol. XII, p. 393, fig. 506, 1852.

Standella falcata GLD., CARPENTER, Brit. Assn. Rept. 1863, p. 640. GABB, Pal. Cal., Vol. II, p. 92, 1869. =*S. nasuta* GLD. (*fide* COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 266). KEEP, West Coast Shells, p. 188, 1892.

Mactra planulata var. *falcata* GLD., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 187.

Shell of medium size, transversely ovate-triangular, convex, rather thin; umbones about central, elevated; anterior dorsal margin nearly straight; anterior extremity rounded near base; ventral margin subarcuate; posterior dorsal margin slightly arcuate, and in left valve forming a slight angle behind umbo; posterior extremity not quite as sharply rounded as anterior extremity; submarginal posterior ridge rounded, not prominent; hinge as in *catilliformis*, except cartilage-pit less prominent; pallial sinus rather long, with rounded extremity, horizontal; two broad, flat ridges radiate from umbo on interior surface, forming a long, triangular depression between them.

Dimensions.—Long. 41 mm.; alt. 28 mm.; diam. 15 mm.

Distinguishable from other species by narrower, more acutely rounded anterior end, and interior radiating ridges. Resembles *M. californica*, but is distinguishable by smaller pallial sinus, lack of ridge between cartilage-pit and anterior ligamental groove, and by the interior radiating ridges and narrower anterior end. Specimens identified by Dr. Dall.

Found in the lower San Pedro series at San Pedro and Deadman Island; and in the upper San Pedro series at San Pedro, Deadman Island, Crawfish George's and Los Cerritos. Also found in Pleistocene at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Kodiak, Alaska, to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper; Arnold).

Pliocene.—Eagle Prairie, Humboldt County; Kirker's Pass, Contra Costa County (Cooper).

Miocene.—Martinez; Half Moon Bay, San Mateo County; Sunol, Alameda County; Siebeck's, Santa Clara County; Griswold's, San Benito County; Foxin's, Santa Barbara County; Santiago, Los Angeles County (Cooper).

Subfamily PTEROPSIDINÆ.

Genus **Labiosa** (*Schmidt*) *Möller*.

Shell large, thin, inflated, broad and gaping behind, beaks adjacent; surface concentrically striate; dorsal areas well defined; pallial sinus short, rounded, wide; ligament marginal, set off by a prominent lamina of shell from the pit; a single obsolete and very short lateral in each valve before and behind the pit; hinge-plate flattish behind, depressed and excavated in front.

Type, *Mactra anatina* Spengler.

Subgenus **Ræta** *Gray*.

Shell acutely rostrate behind; dorsal areas obscure, the surface of the valves more or less vermiculate; pallial sinus deep, narrow, pointed; ligament submerged, except at the anterior end, set off by a shelly ridge which roofs the apex of the pit, and partially supports the posterior arm of the cardinal tooth; left cardinal small; right cardinal with anus coalescent above; a single anterior and posterior lateral in each valve.

Type, *Lutraria canaliculata* Say.

129. **Labiosa (Ræta) undulata** *Gould*.

Lutraria undulata GLD., Proc. Bost. Soc. Nat. Hist., Vol. IV, 1851, p. 89; Bost. Jour. Nat. Hist., Vol. VI, 1853, p. 391, Pl. XV, fig. 7.

Ræta undulata GLD., CARPENTER, Brit. Assn. Rept., 1863, p. 640.

Lutraria transmontana CON. (*fide* COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 247) [in part].

Shell of medium size, ovate, ventricose, thin; beaks a little anterior to center; anterior broadly rounded and tumid; posterior narrowed, compressed and acutely rounded, the dorsal margin being a rectilinear slope, gaping; surface concentrically undulated; cardinal tooth strong; posterior lateral tooth small.

The above description was taken from Gould. A small fragment of a shell showing the undulation of this species was found in the lower San Pedro series of Deadman Island. This fragment may have been of a young of *Panopea generosa*, which is undulated in much the same way as *Rata*. Cooper likens this species to Conrad's *Lutraria transmontana* from the "Pliocene of Los Angeles County." One perfect valve from the Pleistocene at Spanish Bight, San Diego. There is no doubt as to the identity of the Spanish Bight specimen.

Living.—San Pedro to Lower California (Carpenter).

Pleistocene.—San Pedro? (Arnold): San Diego (Arnold).

Subfamily *LUTRARIINÆ*.

Genus **Tresus** *Gray*.

Shell large, inequilateral, thin, inflated; siphonal gape very large, pedal gape narrow; ligament minutely sagittate, separated by a shelly lamina from the pit, which lamina is often recurved and patulous; left cardinal high, compressed; laterals small but distinct in both valves; right cardinal feeble.

Type, *Tresus nuttalli* Conrad.

130. **Tresus nuttalli** *Conrad*.

Lutraria (Cryptodon) nuttalli Con., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 225, Pl. XVIII, fig 1.
Schizothærus nuttalli Con., Pac. R. R. Rep., Vol. V, p. 234, Pl. IV, fig. 33, 1853. Cpr., Brit. Assn. Rept., 1863, p. 637, = *Lutraria maxima* Midd., = *Mactra maxima* (Midd.) Rve., = *Lutraria capax* Gld., = *Tresus maximus* (Midd.) H. & A. Adams (*fide* Gabb, Pal. Cal., Vol. II, p. 91, 1869). Tryon, Syst. Conch., Vol. III, p. 161, Pl. CX, fig. 21, 1884. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. Keep, West Coast Shells, p. 205, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 183.
Tresus nuttalli Con., Dall, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 885.

Shell large, subelliptical, convex, equivalve, inequilateral, thin; umbones small, anterior to center; anterior dorsal margin evenly arcuate, sloping to anterior extremity, which is furthest produced below the middle; posterior aperture truncated, gaping; surface sculptured by prominent lines of growth; one small cardinal tooth in each valve; cartilage-pit large, deep, triangular, separated from ligamental groove by ridge; pallial sinus very large, broad, reaching nearly to line perpendicular to beak.

Dimensions.—Long. 103 mm.; alt. 73 mm.; diam. 44 mm.; umbo to anterior extremity 35 mm.; to posterior extremity 68 mm.

Externally the young of this species resemble somewhat the young of *Saxidomus*, but may be distinguished by the thinner, slightly gaping shell, and prominent cartilage-pit. Specimens identified by Dr. Dall.

Common in the upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, and Deadman Island. Found also in the Pleistocene at Spanish Bight, San Diego.

Living.—Alaska to San Diego (Cooper): both sides of North Pacific (Dall).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—Santa Barbara (Cooper).

Superfamily MYACEA.

Family XXXVI. MYACIDÆ.

Genus **Platyodon** *Conrad.*

Shell ventricose, with concentric, undulating striæ, and a small groove from the apex to the ventral margin; posterior side short, radiately striated; spoon-shaped cardinal process dilated and bi-emarginate.

Type, *Platyodon cancellatus* Conrad.

131. **Platyodon cancellatus** *Conrad.*

Mya cancellatus CON., Jour. Acad. Nat. Sci., Phil., Vol. VII, 1837, p. 236, Pl. XVIII, fig. 2.

Platyodon cancellatus CON., CPR., Brit. Assn. Rept., 1863, p. 637. TRYON, Syst. Conch., Vol. III, Pl. CVI, fig. 28, 1884. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 260. KEEP, West Coast Shells, p. 208, fig. 177, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 183. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 858.

Shell of medium size, subelliptical, ventricose, thin; surface sculptured by numerous fine, concentric laminæ of growth, and anterior portion with numerous fine radiating striæ, which are obsolete on the anterior portion; a slight furrow extends from the beak to the base; umbo prominent; anterior end truncated and gaping; posterior end rounded; cardinal tooth very erect, dilated, bi-emarginate.

Dimensions.—Long. 49 mm.; alt. 28 mm.; diam. 22.5 mm.

Although belonging to the *Myacidæ*, this species has somewhat the shape of a *Pholas*, but may be distinguished by its sculpture. Most of the specimens found were in pairs, and in a fine state of preservation. Specimens identified by Dr. Dall.

Rather rare in the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, and Crawfish George's.

Living.—Bolinas Bay to San Diego (Cooper).

Pleistocene.—? Santa Cruz (Cooper): San Pedro (Arnold).

Genus **Cryptomya** *Conrad.*

Shell inequilateral, transverse, oblong, gaping behind; valves with concentric striæ; right valve with a lamellar tooth; left valve with a broad fosset; ligament internal; pallial sinus absent or obsolete.

Type, *Cryptomya californica* Conrad.

132. **Cryptomya californica** *Conrad.*

Sphænia californica Con., Journ. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 234, Pl. XVII, fig. 11. Cpr., Proc. Zool. Soc., 1856, p. 210.

Cryptomya californica Con., Proc. Phil. Acad. Nat. Sci., 1849, p. 121. Cpr., Brit. Assn. Rept., 1863, p. 637. =*C. ovalis* Con. (*fide* Gabb, Pal. Cal. Vol. II, p. 90, 1869). Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 237. Keep, West Coast Shells, p. 205, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 183. Dall, Trans. Wagner Inst. Sci., Vol. III, Part. 4, 1898, p. 859.

Shell rather small, subelliptical, convex, equivalve, subequilateral, thin; anterior extremity biangular, with faint fold running down from umbo to lower portion of this extremity; posterior extremity evenly rounded, slightly more produced below middle; ventral margin slightly arcuate; surface sculptured by numerous fine, concentric, incremental lines; right valve with prominent lamellar tooth, in which is a shallow cartilage-pit or chondrophore; left valve with a broad fosset; pallial sinus obsolete.

Dimensions.—Long. 26.5 mm.; alt. 18 mm.; diam. 5 mm.

Distinguishable from young of *Tresus nuttalli* by the lamellar elevated tooth and obsolete sinus. Specimens identified by Dr. Dall.

Found in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at San Pedro, Deadman Island, Los Cerritos, Crawfish George's, and Long Beach. Found also in the Pleistocene at Twenty-sixth Street and Spanish Bight, San Diego; and at the old irrigating ditch and Barlow's ranch, Ventura.

Living.—British Columbia to Lower California (Dall).

Pleistocene.—San Pedro (Arnold): San Diego well (Cooper): San Diego; Ventura (Arnold).

Pliocene.—Santa Rosa; Twelve Mile-House, San Mateo County; Soquel, Santa Cruz County; San Fernando; San Diego well (Cooper).

Miocene.—Siebeck's, Santa Clara County; Griswold's, San Benito County; Foxin's, Santa Barbara County (Cooper).

Family XXXVII. CORBULIDÆ.

Genus **Corbula** *(Bruguière) Lamarck.*

Valves unequal, the right usually larger, both more or less rostrate; hinge with (in the right valve) a single large tooth below the beak, with a deep resiliary pit behind it, and no lateral laminæ; the left valve without laterals, with a process upon which the resilium and ligament are inserted, in front of a socket, into which the cardinal tooth of the right valve fits; beaks prominent; sculpture variable, never strongly radial; pallial line with a small sinus or none; lunule and escutcheon usually absent; ligament chiefly internal.

Corbula gallica Lam. is a characteristic species.

133. **Corbula luteola** *Carpenter.*

PLATE XVII, FIG. 11.

Corbula luteola CPR., Brit. Assn. Rept., 1863, p. 637. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 236. KEEP, West Coast Shells, p. 204, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 183. DALL, Trans. Wagner Inst. Sci., Vol. III, Part IV, 1898, p. 856.

Shell small, subelliptical, gibbose, thick; beaks, subcentral, small, inconspicuous; anterior extremity evenly rounded; posterior dorsal margin slightly arcuate, sloping down nearly to base, where it turns abruptly, forming an angular extremity; ventral margin arcuate; a sharp submarginal ridge extends from beak to lower portion of posterior extremity; surface sculptured with fine, but distinct, concentric ridges; right valve with one prominent cardinal tooth in front of cartilage-pit; left valve smaller, with a projecting cartilage process; pallial sinus slight; pedal scar distinct from adductor impressions.

Dimensions.—Long. 8 mm.; alt. 5.5 mm.; diam. 3.5 mm.

This species is distinguishable by its peculiar shape, the sharp posterior, submarginal ridge, and the delicate sculpture. Specimens identified by Dr. Dall.

Found in the Pliocene at Deadman Island; in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at San Pedro and Los Cerritos. Also found in the Pleistocene at Twenty-sixth Street, San Diego.

The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—San Pedro to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper; Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Neæra** *Gray.*

Shell globular, attenuated, and gaping posteriorly; right valve a little the smallest; umbone strengthened internally by a rib on the posterior side; cartilage-process spatulate, in each valve, with an obsolete tooth in front, and a posterior lateral tooth; pallial sinus very shallow.

Neæra ornatissima Irb. is a characteristic species.

134. **Neæra pectinata** *Carpenter.*

PLATE XVIII, FIG. 11.

Neæra pectinata CPR., Brit. Assn. Rept., p. 637, 1863.

Shell small, globular, attenuated and gaping behind, thin; umbones anterior; dorsal line straight; anterior extremity evenly rounded; posterior extremity drawn out to a very long, narrow, truncated beak; ventral margin greatly arcuate; surface sculptured by twelve prominent, sharp, radiating ridges; posterior elongation smooth; cartilage-process spatulate, with an obsolete tooth in front.

Dimensions.—Long. 6.5 mm.; alt. 3.4 mm.; diam. 2.3 mm.; umbo to anterior extremity 2.5 mm.; to posterior extremity 4 mm.

This unique little shell is distinguishable by its prominent radiating sculpture and wing-like posterior projection. Specimen identified by Dr. Dall.

One nearly perfect right valve from the lower San Pedro series at Deadman Island was obtained by Mrs. Oldroyd, is figured in this paper, and is now in the collection of Mrs. Oldroyd. Later another valve was found at the same locality by Delos Arnold.

Living.—Puget Sound to Santa Barbara, 40 to 60 fathoms (Carpenter).

Pleistocene. San Pedro (Oldroyd; Arnold).

Family XXXVIII. SAXICAVIDÆ.

Genus **Panopea** *Ménard*.

Shell equivalve, thick, oblong, gaping at each end; ligament external, on prominent ridges; one prominent tooth in each valve; pallial sinus deep.

Mya glycymeris Born. is a characteristic species.

135. **Panopea generosa** *Gould*.

Panopea generosa GLD., Proc. Bost. Soc. Nat. Hist. Vol. III, 1850, p. 215. Wilkes' Exped., p. 385, Pl. XXXIV, fig. 507, 1852.

Glycimeris generosa GLD., H. & A. ADAMS, Gen. Rec. Moll., p. 350, 1853. CPR., Brit. Assn. Rept., 1863, p. 637. GABB, Pal. Cal., Vol. II, p. 89, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 241. KEEP, West Coast Shells, p. 209, fig. 178, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 183. DALL, Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 830.

"Shell large, rather thin, nearly equilateral, the beaks slightly anterior, the dorsal and ventral margins in the full grown shell parallel and nearly straight, the pedal margin evenly rounded, the nymph narrow, and the attached edge of the ligament very short; the pallial sinus wide and shallow.

"*Dimensions.*—Long. 182 mm.; alt. 110 mm.; diameter 60 mm."

Dr. Dall gives the above description of a living, typical *P. generosa* Gould from Puget Sound. In the same paper (Tertiary Fauna of Florida, Trans. Wagner Inst. Sci., Vol. III, Part 4, p. 831) he describes two new varieties of this same species which he thinks have constant differences enough to warrant the separation. Variety *solida* Dall has a heavy, somewhat arcuate, shell, strong nymph, a ligamentary attachment twice as long as in the typical form, and a deep pallial sinus. This and the typical form are found from Puget Sound to San Diego. Variety *globosa* Dall has a short, thin, inflated shell with the beaks nearer the anterior end, which is expanded and rounded in the pedal region; opposite margins not parallel; pallial sinus small and wide. Found at head of Gulf of California.

Dall also classes together *Mya abrupta* Con. and *Glycimeris estrellana* Con., of the Miocene of California and Oregon, and differentiates them from *P. generosa* Gld. under the name *P. estrellana* Con.

Two imperfect valves from the upper San Pedro series at Los Cerritos were identified by Dr. Dall as typical *P. generosa*.

Rare in the Pliocene and lower San Pedro series at Deadman Island; and in the upper San Pedro series at Deadman Island, San Pedro, and Los Cerritos. Found in the Pliocene at Packard's Hill, Santa Barbara.

Living.—Puget Sound to San Diego (Dall).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—Santa Barbara; San Fernando (Cooper): San Pedro; Santa Barbara (Arnold).

Genus **Panomya** *Gray.*

Shell solid, large, irregular, with a single cardinal tooth under the beak in each valve; the pallial line of unconnected rounded impressions.

Type, *Panopea* (*Mya*) *norvegica* Spengler.

136. **Panomya ampla** *Dall.*

Panomya ampla DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 833.
Panopea norvegica MIDD. (pars.) Mal. Ross., Vol. III, p. 78, Pl. XX, fig. 11, 1849 (not of SPENGLER) (*fide* DALL).

Shell large, irregularly subquadrate, ventricose, thick; beaks subcentral, incurved, small, sharp, elevated; anterior extremity rounded, projected furthest above middle; posterior extremity gaping, abruptly and irregularly truncated, with angular corners above and below; basal margin nearly rectilinear; two large folds separate the shell into three parts; one fold extends to the lower posterior angle from the umbo, and the other extends to the lower anterior angle from the umbo; surface roughly sculptured by concentric lines and undulations; one small cardinal tooth in each valve; cartilage-process rather short, projecting; pallial line of unconnected, rounded impressions.

Dimensions.—Long. 55 mm.; alt. 38 mm.; diam. 27 mm.

This species reminds one somewhat of a young *Panopea generosa*, but is distinguishable from that species by the more central beaks, shorter and more irregular shell, two prominent folds, and unconnected pallial line. Specimens identified by Dr. Dall.

Rare in the Pliocene at Deadman Island; several perfect valves found.

Living.—North Pacific, Behring and Okhotsk Seas (Dall).

Pleistocene.—North Pacific, Behring and Okhotsk Seas (Dall).

Pliocene.—San Pedro (Arnold).

Superfamily ADESMACEA.

Family XXXIX. PHOLADIDÆ.

Subfamily *PHOLADINÆ.*

Genus **Zirphæa** *Leach.*

Shell oval, cardinal margin scarcely reflected; no accessory valves, the beaks protected by a membrane; usually a thin, fugacious epidermis; anteriorly greatly gaping.

Type, *Pholas crispata* Linné.

137. Zirphæa gabbii *Tryon.*

Zirphæa gabbii TRYON, Proc. Phil. Acad. Nat. Sci., 1866, p. 144, Pl. I, fig. 1. GABB, Pal. Cal., Vol. II, pp. 52, 88, Pl. XV, fig. 10, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 270. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 818.

Zirphæa crispata (non LINN., Syst. Nat., Ed. X, p. 670, 1859) (*fide* DALL). CPR., Brit. Assn. Rept., 1863, p. 637. KEEP, West Coast Shells, p. 210, fig. 179, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 182.

Shell of medium size, oblong, convex, thin; surface sculptured by concentric laminations, which are much more elevated, and are provided with sharp, rasp-like teeth on the anterior half of the shell; a slightly raised ridge, flanked by two shallow depressions, runs obliquely posteriorly from the umbo, dividing the spiny sculptured area from the concentrically ridged area; valve reflexed from the umbones forward, covering the umbones; each valve is provided with a delicate spoon-shaped tooth or process, which joins the shell just beneath the umbo.

Dimensions.—Long. 72 mm.; alt. 35 mm.; diam. 30 mm.

This species, though closely allied to *Z. crispata*, is pronounced a distinct species by Dr. Dall. Specimens identified by Dr. Dall.

Quite rare in the upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, and Deadman Island.

Pleistocene.—Santa Barbara (Cooper): San Pedro (Cooper; Arnold).

Miocene.—(?) Alameda County (Cooper).

Subfamily *JOUANNETINÆ.*

Genus **Pholadidea** *Goodall.*

Shell with a double anterior accessory plate (protoplax), the other plate present or absent, the valves prolonged behind into leathery or testaceous cups or a tube (siphonoplax) for the protection of the siphons.

Type, *Pholadidea loscombiana* Goodall.

Subgenus **Pholadidea** *s. s.*

Shell with a double, rather small protoplax; the siphonoplax cup-like, the accessory plates wanting; a single radial sulcus.

Type, *Pholadidea loscombiana* Goodall.

Section *Penitella Valenciennes.*

Like *Pholadidea*, but with a small mesoplax, the two parts of the protoplax confluent.

Type, *Pholas penita* Conrad.

138. Pholadidea (Penitella) penita *Conrad.*

Pholas penita CON., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 237, Pl. XVIII, fig. 7, +*P. concamerata* DESH., 1840, +*P. conradi* VAL., 1846 (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 4, 1898, p. 819).

Parapholas penita CON., CPR., Proc. Zool. Soc., 1856, p. 210.

Pholadidea penita CON., CPR., Brit. Assn. Rept., 1863, p. 637. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 259. KEEP, West Coast Shells, p. 212, fig. 181, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 182.

Penitella penita CON., TRYON, Proc. Phil. Acad. Nat. Sci., Monog. Pholad., 1861, p. 87.

Penitella spelæa CON. (*fide* GABB, Pal. Cal., Vol. II, p. 88, 1869).

Shell of medium size, globose-oblong, equivalve, inequilateral, thin; beaks anterior, small, covered by callous plate; transverse furrow from beak to middle of ventral margin; anterior portion of shell with concentric, wavy, lamellæ, which rise to sharp points on the crests of the undulations, the points, taken as a whole, giving the impression of rugose, radiating, raised lines; posterior portion of shell gaping, with surface concentrically sculptured; anterior gap large, closed in adult shell by callous plate; with a small mesoplax, the two parts of the protoplax confluent.

Dimensions.—Long. 35 mm.; alt. 21 mm.; diam. 20 mm.

Rather common in the upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's, and Deadman Island.

Living.—Straits of Fuca to Santa Barbara (Cooper): San Pedro (Williamson).

Pleistocene.—Santa Barbara (Cooper): Harris' ranch, Santa Barbara County (Knecht): San Pedro (Arnold).

Class SCAPHOPODA.[1]

Order SOLENOCONCHIA.

Family XL. DENTALIIDÆ.

Genus **Dentalium** *Linné*.

Shell tube-like, gradually tapering posteriorly; longitudinally ribbed; margin of the aperture sharpened; posterior end with an internal, slightly projecting tube, which is provided with a dorsoventrally elongated opening, the outer layer having a very slight emargination dorsally and ventrally.

Dentalium elephantinum Linn. is a characteristic species.

139. **Dentalium hexagonum** *Sowerby*.

Dentalium hexagonum SBY., Thes. Conch., Vol. III, p. 103, fig. 10. CARPENTER, Brit. Assn. Rept., 1863, p. 648. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238. KEEP, West Coast Shells, p. 114, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 194.

Dentalium neohexagonum SHARP & PILSBRY, Tryon's Man. Conch., Vol. XVII, p. 19, Pl. XI, figs. 74-86, 1898.

Shell small, curved, thin, tapering posteriorly; apex truncate; surface encircled by fine incremental lines and generally by one or two irregular encircling grooves showing interruption in growth; six prominent, equidistant, longitudinal ridges begin at posterior end and become obsolete near aperture; cross-section near posterior end, hexagonal; aperture subcircular.

Dimensions.—Long. 33 mm.; diam. 3 mm.

Somewhat resembles a miniature elephant's tusk in shape.

Rather common in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at San Pedro, Deadman Island, Crawfish George's, Los Cerritos, and Long Beach. Found in the Pleistocene at Barlow's ranch, Ventura; and in the Pliocene at Pacific Beach, and Russ School, and in the Pleistocene at Twenty-sixth Street, Spanish Bight, and Pacific Beach, San Diego.

---

[1] The classification adopted for this division is that used by Dr. W. N. Dall in Part II of the "Contributions to the Tertiary Fauna of Florida." The generic description is from Tryon's "Structural and Systematic Conchology."

Living.—Santa Barbara to Mexico; East Indies; China (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—San Diego well (Cooper): San Diego (Arnold).

140. Dentalium indianorum *Carpenter.*

PLATE VIII, FIG. 4.

Dentalium (*? pretiosum* NUTT., SBY., var.) *indianorum* CPR., Brit. Assn. Rept., 1863, p. 648.
Dentalium indianorum CPR., COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238.
Dentalium pretiosum var. *indianorum* CPR., TRYON, Man. Conch., Vol. XVII, p. 45, Pl. XIII, figs. 4, 5, 6, 8, 1898.

Shell small, curved, tapering posteriorly, heavy; surface with fine incremental rings, and striated posteriorly; cross-section and aperture circular.

Dimensions.—Long. 41 mm.; diam. 3 mm.

Some of the specimens are much more tapering than others. This species is distinguishable from other members of the genus found in this locality by its heavier shell, and by the striations near the posterior end. Specimens identified by Dr. Dall.

Not uncommon in the lower San Pedro series of San Pedro and Deadman Island; rare in the upper San Pedro series at Crawfish George's. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to Santa Barbara (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

141. Dentalium pseudohexagonum *Dall.*

PLATE VIII, FIGS. 12 AND 12*a*.

Dentalium pseudohexagonum DALL, mss.
Dentalium neohexagonum SHARP & PILSBRY., TRYON, Man. Conch., Vol. XVII, p. 19, 1898, Pl. XI, figs. 74-86.

Shell small, curved, tapering posteriorly, rather heavy; surface ornamented with nine prominent, rounded, elevated, longitudinal ridges, with concave interspaces; cross-section nine-sided; aperture round.

Dimensions.—Long. 28 mm.; anterior diam. 2.8 mm.; posterior diam. 1 mm.

Distinguishable from the other members of the genus by the number of the ridges. The specimen described was dark colored, whether natural or not is not known. Specimen identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island; one fine specimen collected by Mrs. Oldroyd, and one by Delos Arnold; one or two specimens from the upper San Pedro series at San Pedro. Found also in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Mrs. T. S. Oldroyd.

Living.—Locality unknown. Reported by Dall.

Pleistocene.—San Pedro (Oldroyd; Arnold): San Diego (Arnold).

142. Dentalium semipolitum *Broderip & Sowerby.*

Dentalium semipolitum Brod. & Sby., Cpr., Brit. Assn. Rept., 1863, p. 648. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 238.

Dentalium semistriatum var. *semipolitum* Brod. & Sby., Tryon, Man. Conch., Vol. XVII, p. 91, Pl. XVI, fig. 54, 1898.

Shell small, thin, tapering posteriorly, curved near posterior extremity; surface ornamented by numerous fine longitudinal ridges; cross-section and aperture circular.

Dimensions.—Long. 10 mm.; diam. 1.4 mm.

Distinguishable from *D. indianorum* by striations along the whole length, and smaller, thinner, and more tapering shell. Specimens identified by Dr. Dall.

Rare in upper San Pedro series at San Pedro, Deadman Island, and Crawfish George's.

Living.—San Diego to Gulf of California (Cooper).

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Diego well (Dall).

Genus Cadulus *Philippi.*

Shell short, more or less inflated in the middle; apical orifice entire, circular, with annular suboblique internal plica remote from the apex.

Cadulus subfusiformis Sars is a characteristic species.

143. Cadulus nitentior *Carpenter.*

Plate VIII, Fig. 15.

Cadulus nitentior Cpr., mss.

Cadulus fusiformis Phil., Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 231.

Cadulus fusiformis Sharp & Pilsbry, Dall, mss.

Shell small, dingy white or lustrous, tapering, falcate, tubular, thin; surface sculptured by numerous incremental lines, and sometimes by slight constrictions; aperture circular.

Dimensions.—Long. 10 mm.; maximum diam. 1.2 mm.

Common in the lower San Pedro series at Deadman Island and San Pedro bluffs. Found in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—California Coast.

Pleistocene.—San Pedro; San Diego (Arnold).

Pliocene.—San Diego well (Cooper).

Class GASTROPODA.[1]

Order OPISTHOBRANCHIATA.

Family XLI. ACTÆONIDÆ.

Genus **Actæon** *Montfort.*

Shell solid, ovate, with a conical, many-whorled spire, spirally grooved or punctate-striate; aperture long, narrow, rounded in front; outer lip sharp; columella with a strong, tortuous fold.

Tornatella fasciata Lam. is a characteristic species.

144. **Actæon traskii** *Stearns.*

PLATE X, FIG. 6.

Actæon traskii STEARNS, Nautilus, Vol. XI, 1897, p. 14; Proc. U. S. Nat. Mus., Vol. XXI, 1899, p. 297, text-fig.

Shell small, conical above, cylindrical, rather solid; sculpture consisting of numerous fine, spiral, impressed lines, which become wider toward the base of the body-whorl, making the lower portion of the shell lirate, and by sharp, close-set, incremental lines; these latter are subordinate to the spiral sculpture; whorls six; suture distinct, narrowly channeled; aperture about two-thirds length of the shell, acutely angular above, rounded and effuse below, finely lirate and glossy within, with a thin glazing on the body-whorl; outer lip thin, simple; columella short and flexuous, with a conspicuous fold curving around the same and thickening the edge of the lip, which is moderately produced in the umbilical region.

Dimensions.—Long. 10 mm.; lat. 5.2 mm.; body-whorl 8.3 mm. aperture 7 mm.

Distinguishable from *Rictaxis punctocælata* by its larger size, more impressed suture, more cylindrical body-whorl, more prominent and effuse anterior plication. Specimens identified by Dr. Dall. Rare in upper San Pedro series of San Pedro.

Found in the Pleistocene at Spanish Bight, from which locality it was originally described. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

? *Living*—San Diego (Stearns).

Pleistocene.—San Pedro (Arnold): San Diego (Stearns; Hamlin; Arnold).

Subgenus **Rictaxis** *Dall.*

Shell like *Actæon*, but with the columella projecting beyond the line of the anterior margin, forming a small, tooth-like projection, or truncate obliquely.

Type, *Tornatella punctocælata* Cpr.

---

[1] The classification of the Gastropoda is that used by Dall in Parts I and II of the "Contributions to the Tertiary Fauna of Florida," and in Bulletin No. 37, United States National Museum. The generic descriptions are for the most part from Tryon's "Structural and Systematic Conchology."

145. Actæon (Rictaxis) punctocœlata *Carpenter.*

PLATE IX, FIG. 6.

Tornatella punctocœlata CPR., Brit. Assn. Rept., 1863, p. 646; Jour. de Conch., Vol. XII, 1865, p. 139. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 267.

Rictaxis punctocœlata CPR., DALL, Am. Jour. Conch., Vol. VII, 1872, p. 136, Pl. XV, fig. 12. TRYON, Syst. Conch., Vol. II, p. 356, Pl. LXXXVII, fig 28, 1883. KEEP, West Coast Shells, p. 125, fig. 115, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 195. TRYON, Man. Conch., Vol. XV, p. 166, Pl. LXIX, fig. 24, 1893. STEARNS, Proc. U. S. Nat. Mus., Vol. XXI, 1899, p. 298.

Shell small, elongate, elliptical, thin; spire small, conical; whorls three or four, convex; sculpture consists of numerous fine, spiral impressed lines; body-whorl slightly ventricose; aperture acutely angular above, rounded below; outer lip thin, simple; columella projecting beyond the line of the anterior margin, or truncate obliquely; one sharp, columellar plait.

Dimensions.—Long. 6 mm.; lat. 2.7 mm.; body-whorl 5 mm.; aperture 3.5 mm.

Distinguishable from *Actæon traskii* by projecting columella, more ventricose body-whorl, less effuse anterior lip, and smaller size.

Rare in the lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at San Pedro. Found also in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Cruz to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold); San Diego (Stearns; Arnold).

Family XLII. TORNATINIDÆ.

Genus **Tornatina** *A. Adams.*

Shell cylindrical or fusiform, spire conspicuous, apex sinistral, suture channeled, columella callous, single plaited.

Tornatina coarctata A. Adams is a characteristic species.

146. Tornatina cerealis *Gould.*

PLATE X, FIG. 5.

Bulla (Tornatina) cerealis GLD., Bost. Jour. Nat. Hist., Vol. VI, 1853, p. 278, Pl. XIV, fig. 9.

Tornatina cerealis GLD., CPR., Brit. Assn. Rept., 1863, p. 647. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 267. TRYON, Man. Conch., Vol. XV, p. 188, Pl. L, figs. 39, 40, 1893.

Shell minute, solid, ovoid-fusiform, white; spire prominent, of three or four whorls rising by regular grades, and mammillate at tip; aperture linear above, gradually widening forward; outer lip salient at middle, and very gradually approaching the body of the whorl posteriorly, unites to it before reaching the suture; columellar margin callous its whole length, with a strong fold at the base.

Dimensions.—Long. 4.5 mm.; lat. 2 mm.; spire 5 mm.; aperture 3.5 mm.

Distinguishable from *T. culcitella* by more angular whorls, mammillate apex, more keeled upper edge of whorl, and smaller size. Specimens identified by Dr. Dall.

Rather common in the upper and lower San Pedro series at San Pedro, and in the lower San Pedro series at Deadman Island. Found also in the Pleistocene at Spanish Bight, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro; San Diego (Arnold).

147. Tornatina culcitella *Gould.*

PLATE X, FIG. 3.

Bulla (Akera) culcitella GLD., Bost. Jour. Nat. Hist., Vol. VI, 1853, p. 377, Pl. XIV, fig 8: Mex. & Cal. Shells, p. 14, Pl. XIV, fig. 8, 1853.

Tornatina culcitella GLD., CPR., Proc. Zool. Soc., 1856, p. 227. CPR., Brit. Assn. Rept., 1863, p. 646. GABB, Pal. Cal., Vol. II, p. 88, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268. KEEP, West Coast Shells, p. 125, fig. 114, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 195. TRYON, Man. Conch., Vol. XV, p. 189, Pl. L, fig. 38, 1893.

Shell small, thin, cylindrical, narrowed posteriorly; spire only slightly elevated; apex acute; whorls four or five, suture appressed, distinct; aperture nearly as long as body-whorl, narrow anteriorly, gradually widening anteriorly to near anterior end, where it quite suddenly retracts to columella; columella with one plait.

Dimensions.—Long. 11 mm.; lat. 5 mm.; body-whorl 10 mm.; aperture 8.5 mm.

Some specimens attain the length of 23 mm.

Common in the upper and lower San Pedro series of San Pedro and vicinity. Found also in the Pleistocene at bath-house, Santa Barbara; at Barlow's ranch, Ventura, and at Twenty-sixth Street and Spanish Bight, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara; Ventura; San Diego (Arnold).

148. Tornatina eximia *Baird.*

PLATE X, FIG. 11.

Tornatina eximia BAIRD, Proc. Zool. Soc., 1863, p. 67. CPR., Brit. Assn. Rept., 1863, p. 647. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268. TRYON, Man. Conch., Vol. XV, p. 189, 1893.

Shell resembles *T. culcitella*, but differs from that species in the following respects: Has a whorl less narrowed anteriorly, a spire depressed nearly to rim of body-whorl, a longer and narrower aperture, and a less prominent plait on the columella.

Dimensions.—Long. 12.4 mm.; lat. 5.5 mm.; body-whorl 12.2 mm.; aperture 11.5 mm.

Specimen identified by Dr. Dall.

One specimen from the Pliocene at Deadman Island which is figured, and is now in the collection of Delos Arnold.

Living.—Vancouver Island to San Diego (Cooper).

Pleistocene.—San Diego (Cooper).

Pliocene.—San Diego well (Cooper): San Pedro (Arnold).

149. **Tornatina harpa** *Dall.*

Tornatina harpa DALL, Am. Jour. Conch., Vol. VII, 1872, p. 136, Pl. XV, fig. 11. KEEP, West Coast Shells, p. 125, 1892.

Shell small, white, of four and a half whorls; tabulate and sharply carinate above, characterized by sharp grooves and raised lines, parallel with the lines of growth, which extend half over the whorls and become obsolete anteriorly; apex mammillated, minute globular, prominent; suture canaliculated; anterior portion of the last whorl smooth; last whorl slightly narrower above; aperture long, narrow, effuse below, with a deep, narrow sinus at the suture; columellar plait obsolete in the adult, rather prominent in the young shells; carina intersected by the grooves and slightly dentate.

Dimensions.—Long. 6 mm.; lat. 3 mm.

Easily distinguishable by the longitudinal sculpture on the upper half of the last whorl.

Rare in the upper and lower San Pedro series at San Pedro. Found in upper San Pedro series at Spanish Bight, San Diego.

Living.—Monterey (Dall): Catalina Island, 10 fathoms (Arnold, 1901).

Pleistocene.—San Pedro; San Diego (Arnold).

Genus **Volvula** *A. Adams.*

Shell subcylindrical, attenuated to a point posteriorly, to which the narrow aperture extends; spire concealed; outer lip sharp; columella with an obsolete anterior plication.

Volvula acuminator Brug. is a characteristic species.

150. **Volvula cylindrica** *Carpenter.*

PLATE IV, FIG. 2.

Volvula cylindrica CPR., Brit. Assn. Rept., 1863, p. 647; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 380. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 270. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 195. TRYON, Man. Conch., Vol. XV, 1892, p. 239.

Shell small, cylindrical; flattened in middle and with margin almost parallel, swelling out anteriorly; suddenly narrowed behind, running out into short, narrow, umbilicated point; aperture length of shell; very narrow posteriorly, gradually broadening into subovate opening at anterior end; surface smooth, except for faint lines of growth parallel to margin of shell.

Dimensions.—Long. 11 mm.; maximum diam. 4.5 mm.

Resembles *Cylichna alba*, but has an extended umbilical point. Dall (Trans. Wagner Inst. Sci., Vol. III, Part 1, 1890, p. 16) mentions a "*Volvula cylindrica*

Gabb" as occurring in the Miocene of San Domingo, and living on the Atlantic Coast near Cape Hatteras. Whether or not this species is identical with the West Coast form the writer is unable to state.

Rare in the lower San Pedro series at Deadman Island. Found in the Pleistocene at Twenty-sixth Street, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.— Santa Barbara to San Diego (Cooper).

Pleistocene.—San Diego (Cooper): San Pedro; San Diego (Arnold).

Family XLIII. SCAPHANDRIDÆ.

Genus **Cylichna** *Loven.*

Shell strong, cylindrical, smooth or punctate-striate; spire minute or truncated; aperture narrow, rounded in front; columella callous, with one plait.

Cylichna arachis Quoy. is a characteristic species.

151. **Cylichna alba** *Brown.*

PLATE X, FIG. 18.

Cylichna cylindracea (non LINN.) CPR., Brit. Assn. Rept., 1863, p. 647. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 238.

Volvaria alba BROWN, Illustr. Conch. G. B., p. 3, Pl. XIX, figs. 43, 44.

Cylichna alba (BROWN) LOVEN. Öfversight K. Vet.-Akad, Förh., 1846, p. 142. TRYON, Man. Conch., Vol. XV, p. 290, Pl. LX, fig. 16, 1893.

Shell small, cylindrical, smooth; spire truncated; aperture narrow posteriorly for about two-thirds length of shell, when the inner lip gradually retracts to the columella, forming a rounded anterior end to the aperture; columella callous, with one plait.

Dimensions.—Long. 10.5 mm.; maximum diam. 4.25 mm.

Specimens identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island, and upper San Pedro series at San Pedro.

Found also in the Pleistocene at Spanish Bight, San Diego, and at Barlow's ranch, Ventura. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Cooper).

Pleistocene.— Santa Barbara; San Diego (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—San Diego well (Cooper).

Family XLIV. BULLIDÆ.

Genus Bulla *Linné*.

Shell oval-globular, smooth, spotted, marbled, or zoned; spire concave, umbilicated; aperture as long as the shell; inner margin without columella; outer lip trenchant.

Bulla ampulla Linn. is a characteristic species.

152. Bulla punctulata *A. Adams*.

Bulla punctulata A. AD., Thes. Conch., Vol. II, p. 604. CPR., Proc. Zool. Soc., 1863, p. 359. TRYON, Man. Conch., Vol. XV, Pl. 37, fig. 39; Pl. XXXVI, figs. 29, 30, 1893.
Bulla punctata A. AD., Thes. Conch., Vol. II, p. 577, Pl. CXXIII, fig. 77; not of SCHROETER.
Bulla adamsii MENKE, Zeit f. Mol., p. 162, 1850. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 230.

Shell of medium size, subglobular, thin; spire lacking; aperture full length of shell, broadly ovate in front, narrowed posteriorly; outer lip thin, simple, gradually rounded near umbilicus; inner lip and columella incrusted; umbilical pit at posterior end, deep, effuse.

Dimensions.—Long. 32 mm.; alt. 23 mm.; aperture 32 mm.

The shell described was an average specimen, some of the shells being larger and some much smaller. Specimens identified by Dr. Dall.

This species is distinguishable from *B. nebulosa* by its longer, narrower, more cylindrical body-whorl. *B. punctulata* is a southern shell, and is found but rarely as far north as San Diego. *B. nebulosa* is the common form now living at San Pedro.

Rather common in the upper San Pedro series of Deadman Island, Los Cerritos, Crawfish George's, and San Pedro.

Living. San Pedro to Panama (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold).

Pliocene. San Fernando (Cooper).

153. Bulla quoyi *Gray*.

PLATE VIII, FIG. 8.

Bulla quoyi GRAY, Trav. in New Zealand, Dieffenbach, Vol. I, p. 243, No. 113. CPR., Brit. Assn. Rept., 1863, p. 646.

Shell small, elliptical; aperture extending full length of shell; ovate in front, somewhat narrowed behind; outer lip thin, angulated at posterior end; umbilicus at posterior end deep, not very effuse; columella incrusted, the incrustation covering the anterior umbilical region.

Dimensions.—Long. 8 mm.; alt. 5 mm.; aperture 8 mm.

The specimen described is a young shell. Identified as *Bulla quoyi* by Dr. Dall. Distinguishable from *B. punctulata* by angulation of outer lip near posterior umbilicus, and the much sharper curve of the anterior lip.

Rare in upper San Pedro series of San Pedro; one young specimen found, which is figured, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to Lower California (Carpenter).

Pleistocene.—San Pedro (Arnold).

Genus **Haminea** *Leach.*

Shell oval-globular, spiral ventricose, corneous, thin, covered by a slight, smooth epidermis; spire involute.

Haminea hydatis Linn. is a characteristic species.

154. **Haminea virescens** *Sowerby.*

PLATE VIII, FIG. 18.

Bulla virescens SBY., Gen. Rec. Moll., No. XXXIX, fig. 2. A. ADAMS, Thes. Conch., Vol. II, p. 579, Pl. CXXIV, fig. 83, 1850. CPR., Brit. Assn. Rept., 1863, p. 646. = *H. cymbiformis* CPR. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 1, 1890, p. 18). KEEP, West Coast Shells p. 126, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 195. TRYON, Man. Conch., Vol. XV, p. 360, Pl. XL, fig. 5; Pl. XLIII, fig. 19, 1893.

Shell small, subglobular, thin; spire wanting; aperture full length of shell; posterior portion of lip projects only slightly beyond apex; anterior part of aperture broadly ovate, tapering into a canal at the posterior extremity; surface smooth and shell translucent.

Dimensions.—Long. 7 mm.; alt. 6 mm.; aperture 7 mm. × 4.5 mm.

One of the specimens shows the green color of the living shells. Dr. Dall says of this species: "The specimens (Caloosahatchie beds) have been compared with typical specimens of *H. virescens*, and agree exactly. This is one of the cases where, so far as known, a species formerly inhabiting both coasts of North America has become extinct since Pliocene times on one side of the continent while persisting on the other. It is quite possible, however, that a more thorough exploration of the Antillean region would show the species still living there."

Rare in upper San Pedro series of San Pedro; two specimens found. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

Pliocene.—Caloosahatchie beds, Florida (Dall).

Order PULMONATA.

Suborder STYLOMMATOPHORA.

Superfamily MONOTREMATA.

Family XLV. HELICIDÆ.

Genus **Helix** *Linné.*

Subgenus **Epiphragmophora** *Strobel.*

Shell umbilicate, fusco-calcareous; peristome expanded, nearly circular; a solid calcareous epiphram.

Helix cuyana Strobel is a characteristic species.

155. **Helix (Epiphragmophora)** sp. indet.

Shell small, flattened, globosely conoidal; spire only slightly elevated; whorls three or four, slightly convex; umbilicus narrow, deep; peristome expanded, nearly circular.

An imperfect specimen of this genus was found in the lower San Pedro series and sent to Dr. Dall, who pronounced it a member of the above genus.

Living.—(?)

Pleistocene.—San Pedro (Arnold).

Superfamily HYGROPHILA.

Family XLVI. LIMNÆIDÆ.

Subfamily *PLANORBINÆ.*

Genus **Planorbis** *Guettard.*

Shell discoidal, biconcave, the whorls visible on both sides; aperture small, rounded; margin usually simple, sometimes expanded.

Planorbis corneus Linné is a characteristic species.

156. **Planorbis tumidus** *Pfeiffer.*

PLATE IX, FIG. 13.

Planorbis tumidus Pfeiff., Proc. Zool. Soc., 1861, p. 232. CPR., Brit. Assn. Rept., 1863, p. 558.

Shell small, discoidal; spire, except last one and three-fourths whorls, slightly depressed; whorls four, breadth and height about equal; suture deeply impressed, the whorls sloping toward it; base cup-shaped, exhibiting all of the whorls; aperture exhibiting a slightly oblique section of a somewhat angular cylinder; lip embracing over half of body-whorl and joined by callus.

Dimensions.—Alt. 5 mm.; maximum diam. 12 mm.

Distinguishable from *P. vermicularis* by less sloping upper side of body-whorl, less depressed spire, and lip that is not expanded. Specimens identified by Dr. Dall.

Rare in upper and lower San Pedro series of San Pedro; three specimens. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Guatemala (Carpenter).

Pleistocene.—San Pedro (Arnold).

157. **Planorbis vermicularis** *Gould.*

PLATE IX, FIG. 14.

Planorbis vermicularis GLD., Proc. Bost. Soc. Nat. Hist., Vol. II, 1847, p. 212; Wilkes' Expl. Exped., Vol. XII, p. 112, fig. 131, 1852. CPR., Brit. Assn. Rept., 1863, p. 675.

Shell small, dome-shaped; spire sunken into cup-shaped depression below upper margin of body-whorl; whorls four, breadth and height about equal, the last one deflected near the aperture, rounded at periphery; suture very deep, the whorls sloping toward it; base cup-shaped, exhibiting all of the whorls; aperture exhibiting a very oblique section of a cylinder; slightly expanded, embracing about one-half the height of the last whorl, and joined by callus.

Dimensions.—Alt. 6 mm.; maximum diam. 11.5 mm.

Specimens identified by Dr. Dall.

Rare in the upper and lower San Pedro series at San Pedro; three specimens. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Interior of Oregon (Gould).

Pleistocene.—San Pedro (Arnold).

Family XLVII. PHYSIDÆ.

Genus **Physa** *Draparnaud.*

Shell ovate, sinistrally spiral, thin, polished; aperture rounded in front.

Physa fontinalis Linn. is a characteristic species.

158. **Physa heterostropha** *Say.*

Physa heterostropha SAY, Nicholson's Encycl., Pl. LXIX, fig. 6. CPR., Brit. Assn. Rept., 1863, p. 674. KEEP, West Coast Shells, p. 118, fig. 107, 1892.

Shell small, sinistral, shining, pellucid; whorls five ventricose; suture distinct; aperture oval; outer lip thin; pillar lip strong and forms a conspicuous sinus where it joins the whorl above.

Dimensions.—Long. 12 mm.; lat. 7 mm.; body-whorl 10 mm.; aperture 8 mm.; defl. 95 degrees.

This fresh-water form, together with several other species having the same habitat, was found in the lower San Pedro beds at San Pedro. There is no doubt as to their occurrence in these marine deposits, into which they were probably washed by some fresh-water stream.

Living.—North America.

Pleistocene.—San Pedro (Arnold).

Superfamily DITREMATA.

Family XLVIII. AURICULIDÆ.

Subfamily *MELAMPINÆ.*

Genus **Melampus** *Montfort.*

Shell oval-conoidal, or suboval, solid; spire rather short; aperture elongated, narrow; columellar lip with several dentiform plications; columella plicate; outer lip sharp, interior with revolving ridges.

Melampus luteus Quoy is a characteristic species.

159. Melampus olivaceus *Carpenter.*

Melampus olivaceus CPR., Mazatlan Cat., No. 235; Brit Assn. Rept., 1863, p. 647. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 250. KEEP, West Coast Shells, p. 124, fig. 113, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 196.

Shell small, thin, pyriform; spire solid, conical, barely elevated; whorls four or five, flat; body-whorl comprises most of shell, slightly angulated above; suture appressed, wavy; aperture long, narrow, rounded anteriorly; outer lip thin; inner lip incrusted, and with one prominent plication, and sometimes one or two more smaller ones; one prominent plication on columella; umbilicus subperforate.

Dimensions.—Long. 12 mm.; lat. 9 mm.; aperture 9.5 mm.

Somewhat resembles a small, thin, depressed *Conus californicus.*

Found in all of the lower and upper San Pedro localities. Also found in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—Salinas River to Mazatlan (Cooper).

Pleistocene.—San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Diego well (Dall).

Superfamily PETROPHILA.

Family XLIX. GADINIIDÆ.

Genus Gadinia *Gray.*

Shell obliquely conical; muscular impression horseshoe-shaped, the right side shortest, terminating at the siphonal groove.

Gadinia afra Gray is a characteristic species.

160. Gadinia reticulata *Sowerby.*

Mouretia reticulata SBY., Proc. Zool. Soc., 1835, p. 6.

Gadinia reticulata SBY., H. & A. ADAMS, Gen. Rec. Moll., Vol. I, p. 463, 1853. CPR., Brit. Assn. Rept., 1863, p. 666. DALL, Am. Jour. Conch., Vol. VI, 1871, p. 11, Pl. II, figs. 1 to 9; Pl. IV, figs. 1, 2 and 3. KEEP, West Coast Shells, p. 98, fig. 83, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 196.

Rowellia sp. CPR., Brit. Assn. Rept., 1863, p. 651.

Gadinia (Rowellia) radiata COOPER, GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 188. COOPER, Geogr. Catal. Moll., p. 24, No. 460, 1867.

Rowellia radiata COOPER, Am. Jour. Conch., Vol. VI, 1871, p. 319.

Gadinia radiata COOPER, DALL, Am. Jour. Conch., Vol. VII, 1872, p. 192.

Gadinia reticulata var. *radiata* COOPER, Bull. No. 4, Cal. St. Min. Bureau, 1894, p. 26.

Shell conical; apex central, smooth, blunt; surface sculptured by numerous rounded, radiating ridges, made somewhat nodose by concentric, elevated lines of growth; aperture slightly ovate; inner surface smooth; lip smooth, effuse; color white.

Dimensions.—Long. 15 mm.; lat. 14 mm.; alt. 5 mm.

Somewhat resembles *Acmæa mitra*, but is more depressed, has a less acute apex, and is sculptured radially. One specimen found in upper San Pedro series of San Pedro.

Living.—Lower California (Carpenter): West Coast (Keep): Halfmoon Bay (Arnold).

Pleistocene.—San Pedro (Arnold): San Nicolas Island (Bowers.

Superorder STREPTONEURA.

Order CTENOBRANCHIATA.

Superfamily TOXOGLOSSA.

Family L. TEREBRIDÆ.

Genus **Terebra** *Bruguière.*

Shell elongated, turriculated, narrow, solid; whorls numerous, rather flattened, with superficially impressed sutures; aperture small, ovate, profoundly notched at base; columella oblique.

Terebra nebulosa Sowerby is a characteristic species.

Section *Acus (Humphrey) Gray.*

161. **Terebra (Acus) simplex** *Carpenter.*

Myurella simplex CPR., Brit. Assn. Rept., 1863, p. 657; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 395. GABB, Pal. Cal., Vol. II, p. 78, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. KEEP, West Coast Shells, p. 56, fig, 40, 1892.
Terebra simplex CPR., = *T. variegata* GRAY (*fide* TRYON, Man. Conch., Vol. VII, p. 14, 1885).
Terebra (Acus) simplex CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 207.

Shell small, turreted, slender; apex acute; whorls ten to eleven, flat; sculpture consists of about fourteen faint, transverse ribs, each terminated on anterior end by a prominent node; a pseudo suture separates the row of nodes from the main part of the whorl; incremental lines visible; suture impressed, distinct; aperture subelliptical; outer lip thin, slightly arcuate anteriorly; inner lip smooth; plication on columella; sinus short.

Dimensions.—Long. 33 mm.; lat. 9 mm.; body-whorl 13 mm.; aperture 9 mm.; defl. 18 degrees.

Sculpture in this species is quite variable; some specimens have the row of nodes prominently elevated, others show only a little constriction at upper third of transverse ridge.

Common in upper, rare in lower San Pedro series of the San Pedro region. Rare in the Pliocene of Deadman Island and Timm's Point. Found in the Pleistocene at Barlow's ranch, Ventura, and at Twenty-sixth Street, Spanish Bight, and Pacific Beach, San Diego.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—San Diego well (Dall): San Pedro (Arnold).

Family LI. CONIDÆ.

Genus **Conus** *Linné.*

Shell thick, obconic, whorls enrolled upon themselves, the spire short, or not elevated, smooth or tuberculated; aperture long, narrow, the margins parallel, truncated at the base; the outer lip with a slight sutural sinus.

Conus marmoreus Linn. is a characteristic species.

162. **Conus californicus** *Hinds.*

Conus californicus Hds., Proc. Zool. Soc., 1844; Voy. Sulphur, p. 7, Pl. I, figs. 3, 4, 5, 1844. =*C. ravus* Gld. (*fide* Cpr., Brit. Assn. Rept., 1863, p. 658). Gabb, Pal. Cal., Vol. II, p. 78, 1869. Tryon, Man. Conch., Vol. VI, p 17, Pl. IV, figs. 62, 63, 1884. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 236. Keep, West Coast Shells, p. 54, 1892.

Shell double-conical; spire compact, elevated; apex subacute; whorls seven or eight, flat, smooth, except for incremental lines; suture irregular, appressed; body-whorl conical, subangular anteriorly, spirally ornamented with fine lines, which are most prominent on lower part of whorl; aperture long, narrow, slightly wider anteriorly; outer lip thin, bulging anteriorly; obsolete posterior sinus.

Dimensions.—Long. 34 mm.; lat. 18 mm.; body-whorl 29 mm.; aperture 27.5 mm.; defl. 83 degrees.

The specimens from the Pleistocene are generally much worn, but some of them retain the reddish brown coloration of the spiral lines and upper part of the whorls.

Not uncommon in the Pliocene at Deadman Island and Timm's Point; in the lower San Pedro series at Deadman Island and San Pedro; very common in the upper San Pedro series at Deadman Island, Crawfish George's, Los Cerritos, San Pedro, and Long Beach. Found also at Spanish Bight and Pacific Beach, San Diego.

Living.—Farallon Islands to San Diego; Lower California (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Fernando (Cooper): San Pedro; Stanford University (Arnold).

Family LII. PLEUROTOMIDÆ.

Genus **Pleurotoma** *Lamarck.*

Shell turriculated, fusiform, terminated anteriorly by a straight, more or less long canal; aperture oval; columellar lip smooth, straight or sinuous; outer lip somewhat sinuous, with a posterior sinus.

Pleurotoma babylonia Lam. is a characteristic species.

163. **Pleurotoma perversa** *Gabb.*

Pleurotoma perversa GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 183; Pal. Cal., Vol. II, pp. 6, 73, Pl. I, fig. 10, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 260.
Surcula perversa, GABB, TRYON, Man. Conch., Vol. VI, p. 239, Pl. VI, fig. 79, 1884.

Shell small, sinistral, elongate, slender; whorls eight to eleven, convex; surface smooth except for fine incremental lines which are convexly angulated posteriorly a little above middle of whorl; suture deeply impressed, distinct; aperture elongate-ovate; outer lip arcuate anteriorly; inner lip incrusted; columella smooth; posterior sinus prominent; anterior sinus long, narrow.

Dimensions.—Long. 42 mm.; lat. 11.5 mm.; body-whorl 21 mm.; aperture, including canal, 16 mm.; defl. 18 degrees.

Distinguishable from other members of this family by being sinistral.

Common in the Pliocene and lower San Pedro series at Deadman Island; in lower San Pedro series at San Pedro; and rare in the upper San Pedro series at Deadman Island, San Pedro, and Los Cerritos. Common in upper San Pedro series at Crawfish George's.

Living.—Vancouver Island to Catalina Island (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Subgenus **Borsonia** *Bellardi.*

Shell fusiform; with a plication upon the middle of the columella.

Pleurotoma pyrenaica Rouault is a characteristic species.

164. **Pleurotoma (Borsonia) bartschi,** sp. nov.

PLATE V, FIG. 7; PLATE IX, FIG. 1.

Shell small, fusiform, elongate; apex obtuse, mammilliform; whorls seven, angulated near middle; body-whorl less angulated than those of spire; anterior portion of whorl ornamented with about twelve oblique, transversely elongated nodes, which reach their greatest prominence on the angle of the whorl; body-whorl sometimes smooth and sometimes nodose; posterior portion of whorl flat and smooth except for incremental lines; incremental lines fine, oblique, and angulated convexly posteriorly on upper portion of whorl; suture deeply appressed, distinct; aperture elongate-elliptical; outer lip thin, arcuate anteriorly below posterior sinus; inner lip incrusted; columella nearly straight, incrusted, with one sharp plication in middle of aperture; posterior sinus shallow; anterior sinus prominent.

Dimensions.—Long. 19 mm.; lat. 7 mm.; body-whorl 11.5 mm.; aperture, including canal, 8.5 mm.; defl. 28 degrees.

Distinguishable from *B. dallii* and *B. hooveri* by the prominent nodes on the whorls. Looks very much like *Drillia torosa*, but is easily distinguishable by the plication on columella and more angulated body-whorls. Pronounced a new species by Dr. Dall. Specimens of *Borsonia bartschi* in the State Museum collection of fossils at Berkeley are labeled "*Drillia mæsta.*"

Rare in the Pliocene and lower San Pedro series at Deadman Island. The specimen figured on Plate IX is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum; the specimen figured on Plate V is a stumpy form, which might be called variety *curta*.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

165. Pleurotoma (Borsonia) dalli, sp. nov.

Plate VI, Fig. 2.

Shell small, fusiform; spire elevated; apex mammilliform; whorls eight, sharply angulated a little anterior of middle; body-whorl less angulated than those of spire; posterior portion flat to slightly concave, anterior portion slightly convex; first four whorls slightly nodose on angle; ornamentation consists of fine oblique, incremental lines which are convexly angulated posteriorly just posterior to angle of whorl; suture deeply impressed, distinct; aperture elongate-elliptical; outer lip thin, arcuate anteriorly; inner lip incrusted; columella slightly recurved, with one prominent plication in middle of aperture; posterior sinus prominent; anterior sinus rather short.

Dimensions.—Long. 23.5 mm.; lat. 9 mm.; body-whorl 13 mm.; aperture, including canal, 10 mm.; defl. 27 degrees.

Distinguishable by mammilliform apex, small deflection, sharply angulated, smooth whorls, and plication on columella. Specimens pronounced new species by Dr. Dall.

Rare in lower San Pedro series and Pliocene at Deadman Island. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

166. Pleurotoma (Borsonia) hooveri, sp. nov.

Plate X, Fig. 1.

Shell small, fusiform; apex mammilliform; whorls five or six, angulated slightly anterior to middle; body-whorl less angulated than those of spire; surface smooth, except for incremental lines, which are oblique, and angulated convexly posteriorly a little above angle of whorl; suture deeply impressed, distinct; aperture elliptical; outer lip thin, arcuate anteriorly below posterior sinus; inner lip incrusted; columella incrusted, straight, with one prominent plication in middle of aperture; posterior sinus shallow; anterior sinus short.

Dimensions.—Long. 13 mm.; lat. 6.5 mm.; body-whorl 8.2 mm.; aperture, including canal, 6.5 mm.; defl. 50 degrees.

Distinguishable from *B. dallii* by greatly depressed spire, fewer whorls and lack of nodes on apical whorls. Pronounced a new species by Dr. Dall.

Rare in lower San Pedro series; two found at Deadman Island. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Subgenus **Leucosyrinx** *Dall.*

167. **Pleurotoma (Leucosyrinx) pedroana**, sp. nov.

PLATE IX, FIG. 4.

Shell small, elongated; apex subacute; whorls six, sharply angulated near anterior margin; upper portion of whorls flat; ornamentation consists simply of incremental lines, which are angulated convexly posteriorly a little posterior to the angle of the whorl; lower portion of body-whorl, and sometimes the lower portion of the upper whorls, faintly spirally ribbed; deep sutural canal; aperture ovate; outer lip thin, bulging anteriorly; inner lip smooth; posterior rims shallow and wide; canal long, narrow; columella slightly recurved.

Dimensions.—Long. 17 mm.; lat. 6 mm.; body-whorl 10 mm.; aperture 7 mm.; defl. 22 degrees.

Distinguishable by the deep, canal-like suture and the prominence of the angulation on the lower part of the whorls. Specimens identified by Dr. Dall as being new.

Rare in lower San Pedro series at Deadman Island; three specimens found. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Subgenus **Genota** *Adams.*

Section *Dolichotoma Bellardi.*

Shell mitræform; whorls finely cancellated; aperture elongated, canal short; sinus profound.

Pleurotoma mitræformis Kiener is a characteristic species.

168. **Pleurotoma (Dolichotoma) carpenteriana** *Gabb.*

Pleurotoma (Surcula) carpenteriana GABB, Proc. Cal. Acad, Sci., Vol. III, 1865, p. 183; Pal. Cal., Vol. II, pp. 5, 72, Pl. I, fig. 8, 1869.

Surcula carpenteriana GABB, TRYON, Man. Conch., Vol. VI, p. 239, Pl. VII, fig. 3, 1884. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 266. KEEP, West Coast Shells, p. 57, fig. 41, 1892.

Genota carpenteriana GABB, DALL, Proc. U. S. Nat. Mus., Vol. XII, 1889, p. 303.

Pleurotoma (Dolichotoma) carpenteriana CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 207.

Shell large, fusiform; spire elevated and about as long as the aperture; whorls eight, subflattened on the sides, slightly concave near suture, and very slightly convex anteriorly; surface ornamented with fine spiral ridges, which alternate in size on lower part of body-whorl; suture impressed; aperture narrow, widest in middle; outer lip thin, arcuate anteriorly below the wide, shallow sinus; inner lip smooth, incrusted; canal broad and short.

Dimensions.—Long. 88 mm.; lat. 33 mm.; body-whorl 66 mm.; aperture, including canal, 50 mm.; defl. 38 degrees.

The specimen described is an exceedingly fine specimen, a little above the average in size. Mrs. Oldroyd has over a dozen fine specimens of the living shells of this species, which have been hauled up in the fishermen's nets at San Pedro.

Not uncommon in the upper San Pedro series at San Pedro, Deadman Island, and Crawfish George's. Found also in the Pleistocene at Pacific Beach, San Diego, and at the old irrigating ditch, Ventura.

Living.—Monterey to San Diego (Cooper): Cerros Island (Dall).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—Santa Rosa; San Fernando (Cooper): San Diego well (Dall).

169. **Pleurotoma (Dolichotoma) cooperi**, sp. nov.

PLATE VII, FIG. 3.

Shell large, fusiform; spire elevated, same length as aperture; whorls seven, prominently angulated near middle; upper portion decidedly concave, lower portion slightly convex; first five whorls slightly nodose on angle, rest of whorls smooth on angle, except for roughness caused by incremental lines; surface ornamented with revolving spiral ridges, most prominent on the lower portion of whorls, and with prominent incremental lines, which, following the outline of the lip, are convexly angulated posteriorly on the upper portion of the whorl and concavely angulated on the lower portion; on the upper whorls the nearly equal prominence of the two systems of sculpture give the shell a cancellated appearance; aperture long, narrow, with sides nearly parallel; outer lip thin, arcuate anteriorly below sinus; inner lip smooth, incrusted; posterior sinus shallow, broad; canal short, nearly as wide as aperture.

Dimensions.—Long. 65 mm.; lat. 24 mm.; body-whorl 42.5 mm.; aperture, including canal, 33 mm.; defl. 39 degrees.

Distinguishable by the decided convexity of the upper portion of the whorl, smooth angle and cancellated appearance of upper whorls.

Rare in upper San Pedro series of San Pedro; one specimen found. The specimen figured is the type, which is from the upper San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

170. **Pleurotoma (Dolichotoma) tryoniana** *Gabb.*

Pleurotoma (Surcula) tryoniana GABB, Pal. Cal., Vol. II, p. 6, Pl. I, fig. 9, 1869.
Surcula tryoniana GABB, COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 266.

Shell resembles *P. carpenteriana* in shape; whorls eight, convex anterior to middle, with row of nodes on angle; upper portion of whorls concave; surface ornamented with revolving ridges, rather coarser on lower portion of whorl; suture impressed; aperture elongate, narrow, widest in middle; outer lip thin, bulging below the wide, shallow sinus; inner lip smooth; canal short, broad.

Dimensions.—Long. 75 mm.; lat. 28 mm.; body-whorl 52 mm.; aperture, including canal, 40 mm.; defl. 33 degrees.

Distinguishable by nodose, convex, angular whorls.

Rare in upper San Pedro series of San Pedro. Mrs. Oldroyd has several specimens of this species, which have been hauled up alive in the fishermen's nets at San Pedro.

Living.—San Diego (Cooper): San Pedro (Oldroyd).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold).

Genus **Drillia** *Gray*.

Shell turriculated; aperture oval, oblique; canal short, twisted; columella lip strongly callous above.

Pleurotoma gibbosa Kiener is a characteristic species.

171. **Drillia cancellata** *Carpenter*.

Drillia cancellata Cpr., Brit. Assn. Rept., 1863, p. 658; Proc. Phil. Acad. Nat. Sci., 1865, p. 63. Tryon, Man. Conch., Vol. VI, p. 183, 1884.

Shell resembles *D. inermis* in shape; whorls eight or nine, nearly flat, but slightly angulated near anterior margin; decoration consists of five to six spiral ridges and about twenty-five rather more prominent transverse, slightly oblique ribs, the whole giving the whorls a cancellated appearance; suture impressed, distinct; canal long, prominent.

The four specimens found were young, and no adult has so far been recorded from this formation.

Found in the lower San Pedro series of Deadman Island, and in the upper San Pedro series of Los Cerritos. Found in the Pleistocene at Spanish Bight, San Diego.

Living.—Puget Sound (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

172. **Drillia hemphilli** *Stearns*.

Plate V, Fig. 8.

Drillia hemphilli Stearns, Proc. Cal. Acad. Sci., Vol. V, 1874, p. 80, Pl. I, fig. 3. Tryon, Man. Conch., Vol. VI, p. 185, Pl. XIII, fig. 49, 1884.

Shell small, elongate, slender; apex acute; whorls eight, slightly convex, with fifteen distinct, transverse, slightly oblique, rounded ribs; flat anterior sutural riblet about one-fifth the width of whole whorl; suture impressed, distinct; spiral sculpture consists of a few faint grooves; outer lip thin, bulging anteriorly below posterior sinus, which is deep and narrow; anterior sinus short; inner lip and inner side of columella incrusted.

Dimensions.—Long. 16 mm.; lat. 5 mm.; body-whorl 8 mm.; aperture, including canal, 5.5 mm.; defl. 20 degrees.

The specimen described is the largest one found, the normal length being about 10 mm. Distinguishable by its small size, prominent sutural riblet, and oblique transverse ridges.

Found in lower San Pedro series of Deadman Island and San Pedro, and in the upper San Pedro series of Los Cerritos, San Pedro, and Crawfish George's. Found in the Pleistocene at Barlow's ranch, Ventura; and at Spanish Bight and Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Lower California (Stearns).

Pleistocene.—San Pedro; Ventura (Arnold): San Diego (Stearns; Arnold; Hemphill).

[S. D.] Drillia incisa *Carpenter*.

Drillia incisa CPR., Brit. Assn. Rept., 1863, p. 657. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 239.

Shell like *D. inermis*, except that the spiral sculpture consists of several impressed grooves.

Found in the Pleistocene at Pacific Beach, San Diego.

Living.—Straits of Fuca to Santa Cruz (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Diego (Arnold).

173. Drillia inermis *Hinds*.

PLATE V, FIG. 10.

Pleurotoma inermis HDS., Proc. Zool. Soc., 1843, p. 37; Voyage Sulphur, p. 16, Pl. V, fig. 8, 1844.
Drillia inermis HDS., CPR., Brit. Assn. Rept., 1863, p. 657. GABB, Pal. Cal., Vol. II, p. 72, 1869. TRYON, Man. Conch., Vol. VI, p. 182, Pl. XII, figs. 40 and 43; Pl. XXXII, fig. 42, 1884. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 239.

Shell elongate, slender; spire elevated; apex acute; whorls eight or nine, slightly angulated a little posterior to middle, the posterior portion being slightly concave, and the anterior portion slightly convex; ornamentation consists of nine to eleven rounded, spiral ridges, and numerous prominent transverse ridges following the lines of growth, which are convexly angulated on the angle of whorl; the ornamentation is more prominent on the lower portion of the whorls; suture impressed, distinct; aperture elliptical; outer lip thin, arcuate anteriorly; posterior sinus shallow; anterior sinus rather long; inner lip and inner portion of columella incrusted; columella slightly recurved.

Dimensions.—Long. 30 mm.; alt. 9 mm.; body-whorl 17 mm.; aperture, including canal, 11.5 mm.; defl. 22 degrees.

Distinguishable from *D. penicillata* by longer canal, angulation of whorls, and greater prominence of ornamentation; distinguishable from *D. cancellata* by less deflection and angulation of whorl, except body-whorl, which is more evenly convex than in the latter.

Rare in lower San Pedro series of Deadman Island, and in the upper San Pedro series of Los Cerritos and San Pedro. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold. Found in the Pleistocene at Barlow's ranch, and the old irrigating ditch, Ventura; and at Spanish Bight and Pacific Beach, San Diego.

Living.—Santa Barbara to San Diego; Lower California (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego; Ventura (Arnold).

174. Drillia inermis var. penicillata *Carpenter*.

Drillia penicillata CPR., Brit. Assn. Rept., 1863, p. 658; Jour. de Conch., Vol. XIII, 1865, p. 146. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 239. KEEP, West Coast Shells, p. 56, fig. 38, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 208.
Pleurotoma penicillata CPR., TRYON, Man. Conch., Vol. VI, p. 182, Pl. XII, fig. 40, 1884.

Shell elongated; spire elevated; apex acute; whorls eight, only slightly convex; ornamented with numerous nearly obsolete, rounded, spiral ridges, and fine incremental lines which, reproducing the outline of the lip and posterior sinus, form in the middle of the whorl an angle open anteriorly; transverse ornamentation more prominent on apical whorls; suture impressed, distinct; aperture elliptical; outer lip thin, arcuate anteriorly; posterior sinus shallow, wide; anterior sinus short; columella slightly curved to left; spirally ridged.

Dimensions.—Long. 26.5 mm.; lat. 9 mm.; body-whorl 14.5 mm.; aperture including canal, 11 mm.; defl. 22 degrees.

Distinguishable by the beautiful wavy incremental lines, which are quite prominent in most specimens. Some of the shells reach a length of 40 mm. Grades imperceptibly into *D. inermis*.

Not uncommon in the lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, Long Beach, and Crawfish George's. Found in the Pleistocene at Spanish Bight and Pacific Beach, San Diego; and at the old irrigating ditch and Barlow's ranch, Ventura.

Living.—San Pedro, south; Cerros Island; Lower California (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro (Arnold).

175. **Drillia johnsoni**, sp. nov.

PLATE VIII, FIG. 17.

Shell of medium size, turreted; whorls eight or nine, nearly flat, each crossed by about thirteen prominent, rounded, equal, equidistant, oblique ribs, which begin at anterior portion of whorl and extend for about two-thirds distance across whorl, where they become nearly obsolete; a sutural band occupies the upper third of the whorl; lower portion of whorl with five deep, channel-like sulcations; sutural band with strong, oblique incremental lines; suture appressed, undulating; aperture subelliptical; outer lip arcuate; posterior sinus narrow, rather deep; anterior sinus short, recurved; columella incrusted; body-whorl convex, extended below, with revolving sulcations on lower portion; transverse ridges obsolete on lower portion.

Dimensions—Alt. 32 mm.; lat. 11 mm.; body-whorl 16.8 mm.; aperture, including canal, 12 mm.; canal 2 mm.; defl. 25 degrees.

Resembles *P. montereyensis*, but is distinguishable by larger size, less prominent but more sculptured sutural band, longer and more oblique ribs, and more numerous spiral sulcations. Distinguishable from *P. aurantia* by much larger size, more prominent and more sculptured sutural band, more distinct spiral sulcations, longer and less oblique aperture, and a recurved rather than a straight anterior sinus. Pronounced a new species by Dr. Dall. Named in honor of Henry R. Johnson of Washington, D. C., who has prepared many of the drawings used in illustrating this paper.

Type specimen from upper San Pedro series of San Pedro. The specimen figured is the type, which is now in the United States National Museum. Found also in the upper San Pedro series at Deadman Island by W. B. Barber.

Pleistocene.—San Pedro (Arnold; Barber).

176. **Drillia merriami**, sp. nov.

PLATE VIII, FIG. 7.

Shell small, fusiform, rather thin; apex blunt; whorls seven, somewhat angular, with about fourteen slightly oblique, prominent, rather sharp transverse ridges; these ridges are most prominent on angle of whorl, and become obsolete near anterior margin and at about one-third width of whorl from posterior margin; a narrow sutural band occupies upper one third of whorl; incremental lines visible; suture deeply impressed, distinct; body-whorl somewhat ventricose and narrowed anteriorly, with transverse ribs sometimes obsolete; aperture broadly elliptical, narrowed anteriorly to a prominent sinus; posterior sinus small, near suture; outer lip arcuate, thin; columella smooth.

Dimensions.—Long. 14.2 mm.; lat. 5.2 mm.; body-whorl 7.6 mm.; aperture, including canal, 6 mm.; canal 1.5 mm.; defl. 31 degrees.

This species somewhat resembles *Borsonia bartschi*, but may be distinguished by lack of columellar plait, longer but less oblique transverse ridges, and narrower sutural band. Distinguishable from *D. hemphilli* by lack of spiral sulcations, less oblique ribs, much longer body-whorl, and much more prominent canal. Distinguishable from *D. torosa* by lack of spiral lines, narrower sutural band, less convex whorls, and more and longer ribs. This species is said by Dr. Dall to be near the Panama species *D. pallida* Sby. Named in honor of Dr. John C. Merriam, Professor of Paleontology in the University of California, who has assisted the writer in many ways in the preparation of this paper.

Rare in Pliocene and lower San Pedro series of Deadman Island. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

177. **Drillia montereyensis** *Stearns.*

Pleurotoma (Drillia) montereyensis STEARNS, Proc. Cal. Acad. Sci., Vol. V, 1873, p. 80, Pl. I, fig. 21. TRYON, Man. Conch., Vol. VI, p. 184, Pl. XII, fig. 30, 1884.

Shell small, elongate, slender; seven moderately rounded whorls, upper portion of volutions concavely angulated and ornamented with fine spiral ribs and furrows; middle of upper whorls and upper part of body-whorl displaying fifteen equidistant, longitudinal, nodose, slightly oblique ribs; on the smaller volutions of the spire a puckering at and following the suture suggests a second indistinct series of nodules; aperture less than half the length of shell; canal short; posterior sinus rather broad, rounded and of moderate depth.

Dimensions.—Long. 15 mm.; lat. 6 mm.; body-whorl 8.4 mm.; aperture 6 mm.; defl. 22 degrees.

Resembles a large *D. hemphilli* in shape, but has a very distinctive ornamentation.

Rare in the lower San Pedro series at Deadman Island; of the two specimens found, one was obtained by Mrs. Oldroyd.

Living.—Monterey (Stearns).

Pleistocene.—San Pedro (Oldroyd; Arnold).

178. **Drillia pudica** *Hinds*.

PLATE VIII, FIG. 13.

Pleurotoma pudica HDS., Proc. Zool. Soc., 1843, p. 41; Voyage Sulphur, p. 20, Pl. VI, fig. 11, 1844. CPR., Brit. Assn. Rept., 1856, p. 330. TRYON, Man. Conch., Vol. VI, p. 189, Pl. XIII, fig. 55, 1884.

Shell small, resembling *D. torosa* in general appearance; whorls seven, angular, convex below, concave above, with twelve or thirteen transverse ribs, nearly all of which extend from suture to suture, but less prominent on the concave surface; surface spirally sulcate; in other respects similar to *torosa*.

Dimensions.—Long. 11 mm.; lat. 4 mm.; defl. 25 degrees.

Distinguishable from *D. torosa* by the long transverse ribs, and by the more convex outline of the whole shell. Specimen identified by Dr. Dall.

Rare; one specimen from upper San Pedro series of San Pedro, which is figured, and is now in the collection of Delos Arnold.

Living.—Central America (Carpenter).

Pleistocene.—San Pedro (Arnold).

179. **Drillia renaudi**, sp. nov.

PLATE VIII, FIG. 5.

Shell small, fusiform, turreted; apex blunt; whorls eight, sharply angular, with angle about two-fifths distance from anterior margin of whorl; upper and lower surfaces flat; about fifteen oblique nodes ornament the angle and extend down on the lower portion of the whorl, becoming obsolete before reaching the suture; nodes obsolete on body-whorl; suture deeply impressed, distinct; aperture short, elliptical, oblique; posterior sinus broad, shallow; anterior sinus long, straight; columella incrusted within; body-whorl angular, ventricose, much produced and narrow below, smooth, except for very faint incremental lines.

Dimensions.—Long. 15.8 mm.; lat. 6 mm.; body-whorl 9 mm.; aperture, including canal, 7 mm.; canal 2 mm.; defl. 35 degrees.

Different in shape from any other member of this genus found in these deposits. Distinguishable by the smooth, ventricose body-whorl, sharply angulated whorls, nodose angle, and long canal. This species has the long canal of *D. perversa*, the angular whorls of *Leucosyrinx pedroana*, and the nodes, though less prominent, of *D. torosa*. Specimens pronounced a new species by Dr. Dall. Named in honor of Ralph E. Renaud, who has prepared many of the drawings which illustrate this paper.

Rare; one specimen from Pliocene and one (type) from lower San Pedro series of Deadman Island. The specimen figured is the type, which is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

180. **Drillia torosa** *Carpenter.*

Drillia torosa CPR., Brit. Assn. Rept., 1863, p. 657; Jour. de Conch., 3rd Ser., Vol. XV, 1865, p. 145. TRYON, Man. Conch., Vol. VI, p. 183, Pl. XIV, fig. 93, 1884. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 239. KEEP, West Coast Shells, p. 56, fig. 59, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 298.

Shell elongated; spire elevated; apex acute; whorls eight, angulated near middle, with row of about nine nodes, transversely elongated, on angle; the upper portion of whorl flat to concave; anterior half of whorl spirally striated; incremental lines visible, oblique, and on upper part of whorl, concave anteriorly; suture impressed, distinct; lower portion of body-whorl and columella spirally striated; aperture elliptical; outer lip thin and arcuate anteriorly; inner lip and columella slightly incrusted; posterior sinus shallow; anterior sinus short, straight.

Dimensions.—Long. 25 mm.; lat. 8 mm.; body-whorl 14.5 mm.; apbrture, including canal 9.5 mm.; defl. 22 degrees.

Distinguishable by the nodose whorls. The relative length of canal varies somewhat in this species, as does also the prominence of the nodes.

Found in the Pliocene at Deadman Island and Timm's Point; in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, and Crawfish George's. Most common in the lower formations.

Living.—Santa Cruz to Santa Barbara (Cooper): San Pedro (Williamson).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Bela** *Gray.*

Shell oval, fusiform, thin; spire produced; canal short; sinus small, near the suture; columella flattened; operculum pointed at both ends.

Pleurotoma turricula Montf. is a characteristic species.

181. **Bela fidicula** *Gould.*

PLATE VII, FIG. 10.

Fusus fidicula GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1849, p. 142; Wilkes' Expl. Exped., Vol. XII, p. 233, fig. 284, 1852.

Bela fidicula GLD., CPR., Brit. Assn. Rept., 1863, p. 658. TRYON, Man. Conch., Vol. VI, p. 222, Pl. XXXII, fig. 17, 1884.

Shell small, thin, turreted, short, fusiform; whorls seven, angular, forming a broad shoulder at the suture; surface sculptured with delicate, regular, obtuse, transverse rib-folds, about twenty-four on the last whorl, on the middle of which they disappear, decussated by more crowded, delicate grooves, a little undulating, about eight on the penultimate whorl; suture deeply impressed, distinct; aperture narrow, elliptical; outer lip thin, slightly arcuate; pillar smooth interiorly, spirally striate externally; canal short.

Dimensions.—Long. 10 mm.; lat. 4.1 mm.; body-whorl 6.8 mm.; aperture 5 mm.; defl. 30 degrees.

Found in Pliocene at Deadman Island, lower San Pedro series at Deadman Island, and upper San Pedro series at Crawfish George's. Found also in the Pleistocene in bluff west of bath-house, Santa Barbara, and at old irrigating ditch, Ventura. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound (Carpenter).

Pleistocene.—San Pedro; Santa Barbara; Ventura (Arnold).

Pliocene.—San Pedro (Arnold).

182. **Bela sanctæ-monicæ**, sp. nov.

PLATE VIII, FIG. 14.

Shell small, broadly fusiform; spire elevated; apex subacute; whorls five, convex, slightly angular above, with about sixteen prominent, rounded ribs, which extend from suture to suture; surface sculptured with spiral sulcations; suture deeply impressed, distinct; aperture slightly oblique, subelliptical; canal short; body-whorl ventricose, lacking transverse sculpture on lower portion; pillar smooth.

Dimensions.—Long. 12 mm.; lat. 7.5 mm.; body-whorl 8.5 mm.; aperture, including canal, 6.8 mm.; canal 1 mm.; defl. 50 degrees.

Distinguishable from *B. fidicula* by much broader form, fewer and less sharply angular whorls, and more ventricose body-whorl, and less elevated spire. The type specimen was examined by Dr. Dall, who pronounced it a new species.

Type from lower San Pedro series (Pleistocene) at Port Los Angeles, near Santa Monica. Five specimens of the same species, with slightly more angulated whorls, were found in the lower San Pedro series of Deadman Island. The specimen figured is the type, which is now in the United States National Museum.

Pleistocene.—San Pedro; Port Los Angeles (Arnold).

Genus **Mangilia** *(Leach) Risso.*

The present genus includes all *Pleurotomidæ* without opercula.

Subgenus **Clathurella** *Carpenter.*

Shell fusiform or turriculated; columella lip without callosity, except a small posterior tooth; no operculum; the cancellated surface, more ventricose form, and more evident canal, distinguish it from *Mangilia*; the emargination of the outer lip from *Clavatula*; the texture and sculpture of the surface from *Bela* and *Daphnella.*

Pleurotoma linearis Blainv. is a characteristic species.

183. **Mangilia (Clathurella) conradiana** *Gabb.*

Clathurella conradiana GABB, Pal. Cal., Vol. II, p. 7, Pl. I, fig. 12, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 235.

Shell small, robust, broadly fusiform; spire high, whorls seven, the first smooth and round, the remainder angulated, concave above, convex below; surface ornamented by ten or twelve rounded transverse ribs, crossed by square elevated ribs, with sometimes smaller ones interposed; on the upper or concave part of whorl are several fine, revolving lines; suture deeply impressed, distinct; aperture long, narrow; posterior sinus near suture deep, prominent; anterior sinus short, recurved; outer lip arcuate; pillar straight, spirally striate.

Dimensions.—Long. 11.5 mm.; lat. 4.5 mm.; body-whorl 6.9 mm.; aperture 5.5 mm.; defl. 35 degrees.

Distinguishable by deep posterior sinus from other members of the same family. (Originally described from Pleistocene specimen.) Pronounced as "near *C. canfieldii* Dall," by Dr. Dall.

Rather common in the Pliocene and lower San Pedro series of Deadman Island; rare in the lower San Pedro series and upper San Pedro series of San Pedro. Found in the Pliocene at Packard's Hill; and in the Pleistocene at the bath-house, Santa Barbara.

Living.—San Pedro (Raymond).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara (Arnold).

Pliocene.—San Pedro; Santa Barbara (Arnold): San Diego well (Dall).

Subgenus **Cythara** *Schumacher*.

Shell fusiform, polished, longitudinally ribbed; aperture linear, truncated in front, slightly notched behind; outer lip margined, denticulated within; inner lip frequently finely striated.

Pleurotoma stromboides Reeve is a characteristic species.

184. **Mangilia (Cythara) branneri**, sp. nov.

PLATE IX, FIG. 10.

Shell small, fusiform; spire elevated; apex rounded; whorls six; slightly convex, with six sharp, slightly oblique, transverse ribs arranged in slightly twisted lines radiating from the apex; suture impressed, distinct; aperture narrow, truncated in front, slightly notched behind; outer lip margined; inner lip smooth.

Dimensions.—Long. 10 mm.; lat. 4 mm.; body-whorl 6 mm.; aperture 4.5 mm.; defl. 27 degrees.

Distinguishable by the few longitudinally connected, sharp, radiating ridges. Pronounced by Dr. Dall as probably being new. Named in honor of Dr. John C. Branner, Professor of Geology in Leland Stanford Jr. University.

Rather common in lower San Pedro series of Deadman Island. Found also in the Pleistocene at bath-house, Santa Barbara. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro; Santa Barbara (Arnold).

Subgenus **Mangilia** *Risso*, *s. s.*

Fusiform, mostly longitudinally ribbed, spire elongated, turriculated, acuminated; canal short, more or less truncated; columella smooth; sinus near the suture. No operculum.

Pleurotoma ponderosa Reeve is a characteristic species.

185. Mangilia angulata *Carpenter*.

PLATE VII, FIG. 9.

Mangilia angulata CPR., Brit. Assn. Rept., 1863, p. 658; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 395. KEEP, West Coast Shells, p. 55, 1892. COOPER, Bull. No. 4, Cal. St. Min. Bureau, 1894, Part 3, p. 27.

Shell small, turreted, elongate-fusiform; apex acute; whorls six, broad and angular, angle being slightly posterior to middle; sculpture consists of ten prominent, rather sharp, transverse ridges which reach maximum prominence on angle of whorl; suture deeply impressed, distinct, aperture oblique, narrow, elliptical, drawn out anteriorly into a short, narrow canal; outer lip thin; simple, arcuate; inner lip smooth.

Dimensions.—Long. 8 mm.; lat. 3.2 mm.; body-whorl 5 mm.; aperture 4 mm.; defl. 33 degrees.

Some of the shells show a very faint spiral sculpture. Distinguishable by broad form and simple transverse sculpture. Specimens identified by Dr. Dall.

Many specimens of this species in the State museum collection of fossils at Berkeley are labeled "*M. variegata.*"

Rather common in the lower San Pedro series of Deadman Island and San Pedro; rare in the upper San Pedro series at Crawfish George's and Los Cerritos. Found also in the Pleistocene at bath-house, Santa Barbara; Barlow's ranch, Ventura, and at Spanish Bight and Pacific Beach, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound to Santa Barbara (Carpenter).

Pleistocene.—San Pedro (Arnold): San Joaquin Bay, Orange County (Bowers): Santa Barbara; Ventura; San Diego (Arnold).

186. Mangilia hooveri, sp. nov.

PLATE IX, FIG. 5.

Shell small, elongate-fusiform, solid; spire elevated; apex mammilliform; whorls six, only slightly convex, with about ten low, rounded, slightly oblique, transverse ridges; the first whorl is smooth, while the next three are more convex than the lower ones, and have traces of spiral sculpture; body-whorl with sculpture nearly obsolete; aperture elliptical, tapering to a very short canal anteriorly; outer lip arcuate, thin; pillar quite long and straight.

Dimensions.—Long. 10.9 mm.; lat. 3 mm.; body-whorl 6 mm.; aperture 4 mm.; defl. 20 degrees.

Distinguishable by the slender form, nearly flat whorls, and the broad, low, transverse ridges. The body-whorl resembles that of a small, elongate-pillared *Drillia.* Pronounced new by Dr. Dall. Named in honor of Mr. T. J. Hoover of Stanford University, California.

Type from upper San Pedro series of San Pedro; rare. The specimen figured is the type, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

187. **Mangilia interfossa** var. **pedroana**, var. nov.

PLATE VI, FIG. 3.

Mangilia interfossa CPR., Brit. Assn. Rept., 1863, p. 658; Ann. & Mag. Nat. Hist., 3d Ser., Vol. XV., 1865, p. 29.

Daphnella interfossa CPR., TRYON, Man. Conch., Vol. VI, p. 310, Pl. XXII, fig. 11, 1884.

Shell small, turreted, elongate-fusiform; apex acuminate; whorls six, convex, ornamented with about sixteen rounded, slightly oblique, transverse ridges and four to six sharp, raised, spiral lines in the interspaces; suture deeply impressed; aperture narrow, slightly oblique, elliptical: outer lip thin, simple; inner lip smooth.

Dimensions.—Long. 7.5 mm.; lat. 2.5 mm.; body-whorl 4.1 mm.; aperture 2.5 mm.: defl. 30 degrees.

Distinguishable from *M. interlirata* by broader form, more convex whorls, and more numerous lines of sculpture. Specimens pronounced new variety of *M. interfossa* by Dr. Dall.

Rare in lower San Pedro series at Deadman Island; and in upper San Pedro series at Crawfish George's. Found also in the Pleistocene at bath-house, Santa Barbara. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro; Santa Barbara (Arnold).

188. **Mangilia interlirata** *Stearns.*

PLATE VI, FIG. 15.

Mangilia interlirata STEARNS, Proc. Cal. Acad. Sci., Vol. IV, 1872, p. 226, Pl. I, fig. 10. TRYON, Man. Conch., Vol. VI, p. 249, Pl. XXII, fig. 56, 1884.

Shell small, elongate, fusiform; spire much elevated; apex acute; whorls six, slightly convex, ornamented by nine or ten slightly oblique, rather narrow, transverse ridges; spiral sculpture consists of three or four sharp raised lines, which extend to base of body-whorl; suture impressed, distinct; aperture narrow, elliptical; outer lip thin, simple; inner lip simple; canal simple.

Dimensions.—Long. 8.8 mm.; lat. 3 mm.; body-whorl, 4.9 mm.; aperture, 3 mm.; defl. 25 degrees.

Distinguishable from *M. interfossa* var. *pedroana* by its slenderer outline, fewer transverse and spiral ridges, and flatter whorls; distinguished from others of the genus by the prominence of its spiral lines. Specimens identified by Dr. Dall.

Rare in lower San Pedro series at Deadman Island, and in the upper San Pedro series at Los Cerritos. The specimen figured is from the Lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—West Coast.

Pleistocene.—San Pedro (Arnold).

189. **Mangilia oldroydi**, sp. nov.

PLATE VI, FIG. 16.

Shell small, turreted, elongate-fusiform; apex acuminate; whorls seven, convex, rather shouldered above, and crossed by sixteen slightly oblique rounded ridges; transverse ridges become obsolete on lower half of body-whorl; spiral sculpture consists of three or four fine raised lines on lower portion of whorl and several microscopic lines on upper portion; the spiral sculpture is more prominent on the body-whorl; suture deeply impressed; aperture narrow pyriform, drawn out on anterior end to a long, narrow, recurved canal; outer lip arcuate, thin, simple; inner lip smooth.

Dimensions.—Long. 16 mm.; lat. 6 mm.; body-whorl 10 mm.; aperture 8 mm.; defl. 38 degrees.

The largest and finest of the Pleistocene *Mangiliæ*. Distinguishable by its large size, rounded ridges, faint shouldered appearance of the whorls, and long, recurved canal. "Different from any of the species in the Smithsonian collection" (Dall).

Rare in lower San Pedro series of Deadman Island; one specimen (type) collected by Mrs. Oldroyd, which is figured, and is now in her collection.

Pleistocene.—San Pedro (Oldroyd).

190. **Mangilia painei**, sp. nov.

PLATE VIII, FIG. 1.

Shell small, elongate-fusiform; spire elevated; apex rounded; whorls seven, evenly convex, with about eleven slightly transverse, rounded ribs, which become obsolete at the sutures; spiral sculpture obsolete; aperture narrow, elliptical, narrowing anteriorly to canal; canal truncate in front; posterior sinus small; outer lip arcuate, thin, with faint ridge on interior; suture deeply impressed; pillar long, smooth within, obsolete sculpture without.

Dimensions.—Long. 12 mm.; lat. 4.2 mm.; body-whorl 8 mm.; aperture, including canal, 6.1 mm.; canal 1.5 mm.; defl. 32 degrees.

Distinguishable by slender form, evenly convex whorls, prominent transverse ribs, and obsolete spiral sculpture; canal also longer than in most species. Resembles *M. oldroydi* in outline, but has no spiral sculpture or angulated whorls. Pronounced a new species by Dr. Dall. Named in honor of Miss Winifred Mabel Paine of Redlands, California, who has drawn many of the figures illustrating this paper.

Not uncommon in the lower San Pedro series of Deadman Island. The specimen figured is the type, which is from the lower San Pedro series of Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

191. **Mangilia sculpturata** *Dall.*

PLATE VI, FIG. 17.

Bela sculpturata DALL, Proc. U. S. Nat. Mus., Vol. IX, 1887, p. 299, Pl. IV, fig. 7.

Shell small, turreted, elongate-fusiform; apex acute; whorls seven, sharply angulated, with flat, sloping surfaces both above and below angle; sculpture consists of eight or nine sharp transverse ridges, and two or three sharp spiral lines on lower portion; aperture very deeply impressed, giving tabulate appearance to whorls; aperture long, narrow, and drawn out into a long, narrow canal at anterior end; outer lip thin, simple; inner lip smooth; spiral sculpture extends to base of pillar.

Dimensions.—Long. 10.5 mm.; lat. 3 mm.; body-whorl 6 mm.; aperture 4 mm.; defl. 23 degrees.

A slender, deeply sutured form, with a comparatively long canal; these characteristics distinguishing it from others of the genus. Specimen identified by Dr. Dall.

Rare in Pliocene and lower San Pedro series of Deadman Island; one specimen from each horizon. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—West Coast.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

192. Mangilia striosa *C. B. Adams.*

PLATE IX, FIG. 3.

Mangilia striosa C. B. ADS., Ann. N. Y. Lyc. Nat. Hist., Vol. V, 1852, p. 147. TRYON, Man. Conch., Vol. VI, p. 249, Pl. XXXIV, fig. 96, 1884. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, p. 208, 1892.

Shell small, elongate-fusiform; spire much elevated; apex acute; whorls six, subangular, with numerous fine, slightly wavy transverse ridges, which become obsolete at the sutures; spiral sculpture nearly obsolete; suture very deeply depressed, giving a rather frail appearance to the spires; aperture narrow, elliptical, tapering anteriorly to a short, truncated canal; posterior sinus small; outer lip thin, simple, arcuate; columella smooth; straight on anterior portion.

Dimensions.—Long. 9.2 mm.; lat. 3 mm.; body-whorl 5.2 mm.; aperture 4 mm.; defl. 22 degrees.

This species is distinguishable by its numerous fine, transverse ridges, deep suture, subangular whorls, and slender form. Resembles *M. sculpturata* somewhat in outline, but has less angular whorls and more numerous, finer ribs. Distinguishable from *M. oldroydi* by the angle being nearer the middle of the whorl, the ridges being finer, the pillar shorter, and the suture deeper. Specimens identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro and Los Cerritos. Found also in Pleistocene at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at Los Cerritos, and is now in the collection of Delos Arnold.

Living.—Panama (Carpenter): San Pedro (Williamson).

Pleistocene.—San Pedro; San Diego (Arnold).

Subgenus Taranis *Jeffreys.*

Shell minute, cancellated; whorls angulated, slightly exserted at base; aperture pyriform; outer lip thin, simple; sinus obsolete; canal short.

Taranis morchii Malm. is a characteristic species.

193. Mangilia (Taranis) strongi, sp. nov.

PLATE IX, FIG. 7.

Shell small, elongated; spire elevated; apex mammilliform; whorls six, angulated near middle, upper surface concave, lower surface convex; two strong spiral ridges, one on angle, the other in middle of lower portion of whorl; incremental lines visible; suture impressed, distinct; aperture subovate, oblique; outer lip thin, slightly arcuate anteriorly; inner lip smooth; posterior sinus broad, very shallow; anterior sinus short; columella short, distinct.

Dimensions.—Long. 12 mm.; lat. 5.5 mm.; body-whorl 7 mm.; aperture 5 mm.; defl. 38 degrees.

Distinguishable from others of the same family by the two strong, revolving ridges. Named in honor of A. M. Strong. Specimens pronounced new species by Dr. Dall.

Rare in the lower San Pedro series of San Pedro and Deadman Island; found also in the Pliocene of Deadman Island, and in the upper San Pedro series at Crawfish George's. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Pliocene.—Santa Monica; San Pedro (Arnold).

Subgenus **Spirotropsis** *Sars.*

Shell elongate, turreted, spire produced; the obtuse apex mammilliform; whorls numerous, carinated in the middle; aperture narrow, oblique, with a short canal; sinus deep; remote from suture.

Pleurotoma carinata Phil. is a characteristic species.

194. **Pleurotoma (Spirotropsis) smithi,** sp. nov.

PLATE VI, FIG. 13.

Shell elongate, turreted, slender; spire elevated; apex obtuse, mammilliform; whorls ten, convex, with a slight tendency toward angulation on the lower third of the whorl, and abruptly terminated at the posterior margin; suture very deeply impressed, distinct; sculpture consists simply of oblique, incremental lines, which are quite deeply angulated convexly, posteriorly just a little above the middle of the whorl; aperture narrow, oblique; outer lip thin, arcuate anteriorly; inner lip smooth and incrusted; posterior sinus deep and remote from suture; canal narrow, slightly recurved, over one-third of the aperture.

Dimensions.—Long. 35 mm.; lat. 11 mm.; body-whorl 8.5 mm.; aperture 13 mm.; defl. 19 degrees.

A long, slender species, slightly resembling the sinistral *P. perversa* in general outline, but easily distinguishable from that species and also from all the other members of this family. Some of the shells are a little more depressed than the type. Specimens identified by Dr. Dall as being a new species.

Not uncommon in the lower San Pedro series and Pliocene of Deadman Island. The specimen figured is the type, which is from the Pliocene of Deadman Island, and is now in the United States National Museum.

Living.—(Locality not mentioned) (Dall).

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Family LIII. CANCELLARIIDÆ.

Genus **Cancellaria** *Lamarck.*

Subgenus **Cancellaria** *s. s.*

Shell oval, cancellated; last whorl ventricose; aperture oblong, canaliculated in front; canal short, sometimes recurved; columella with several large oblique plications.

Type, *Cancellaria cancellata* Linn.

195. **Cancellaria cooperi** *Gabb.*

PLATE VII, FIG. 8.

Cancellaria (*Narona*) *cooperi* GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 186.
Cancellaria cooperi GABB, TRYON, Man. Conch., Vol. VII, p. 76, Pl. IV, fig. 66, 1885. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 211, Pl. XXII, fig. 2.

Shell fusiform; spire elevated, about one-third length of shell; apex subacute; whorls six to seven, angulated, concave above, convex below; lower portion of whorl with ten to fourteen prominent, rounded, slightly oblique ribs which end in tubercles on angle; lower part of whorl ornamented with close-set spiral ridges, alternating in prominence; ridges on upper part of whorl less prominent; body-whorl ventricose and crossed by raised incremental lines; suture appressed, wavy, distinct; aperture semielliptical; outer lip not thickened, denticulated; inner lip heavily incrusted, and with two sharp, oblique plications on lower part; columella slightly twisted, rough; canal short.

Dimensions.—Long. 80 mm.; lat. 35 mm.; body-whorl 56 mm.; aperture, including canal, 35.5 mm.; defl. 40 degrees.

Rare in the upper San Pedro series of San Pedro; five specimens found.

Mrs. Oldroyd has a fine living specimen of this species which was hauled up in the fishermen's nets at San Pedro. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Cooper): San Pedro (Oldroyd).

Pleistocene.—San Pedro (Arnold).

196. **Cancellaria crawfordiana** *Dall.*

Cancellaria crawfordiana DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 182, Pl. VI, fig. 1.

Shell small, fusiform; spire elevated; whorls five or six, acutely angulated above near margin; upper portion flat, forming revolving table; lower portion evenly convex; sculpture very prominent, cancellated, consisting of about twenty-five nearly straight, equidistant, transverse ribs and about ten equidistant spiral ridges of equal prominence with the transverse ones; incremental lines visible between transverse ribs; suture impressed, very distinct; aperture semielliptical; outer lip slightly thickened and faintly denticulate; inner lip not incrusted; columella with two prominent plications on the inner side; canal short and broad.

Dimensions.—Long. 37 mm.; lat. 16 mm.; body-whorl 24.5 mm.; aperture, including canal, 17.5 mm.; defl. 38 degrees.

Resembles *C. cooperi* in shape, but is distinguishable by the prominent cancellated sculpture.

Rare in upper San Pedro series of San Pedro; one specimen found.

Living.—Drake's Bay to San Diego, 20 to 30 fathoms (Dall): San Pedro (Raymond).

Pleistocene.—San Pedro (Arnold).

197. Cancellaria tritonidea *Gabb.*

PLATE VII, FIG. 5.

Cancellaria tritonidea GABB, Pal. Cal., Vol. II, pp. 11, 79, Pl. II, fig. 18, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 183.

Shell large, robust-fusiform; spire elevated, subacute; whorls six, first generally decollated, angulated; upper part of first three and one-half revolutions convex; upper part of lower whorls concave; lower part of all whorls, except body-whorl, generally covered with a lamellar incrustation; ten prominent sharp nodes on angle of whorl; whorls ornamented with numerous prominent, squarish, spiral ridges between which are less prominent raised lines; incremental lines visible, and some of them which pass through the nodes have the prominence of weak varices; suture appressed, wavy, distinct; aperture subovate; outer lip not thickened; inner lip incrusted; columella rough, twisted, widened, with two prominent plications on the inner side; canal short, wide.

Dimensions.—Long. 90 mm.; lat. 60 mm.; body-whorl 70 mm.; aperture, not including canal 50 mm.; defl. 75 degrees.

The shell figured and described in this paper is the largest and most nearly perfect one yet found in this locality. Gabb's type specimen was beach worn and not as well preserved as the one described above, which accounts for the lack of the sharp nodes and more rounded outline of his shell. A specimen in this collection labeled "*Cancellaria vetusta* Gabb, Pliocene, Ventura" by Dr. Bowers, is of the same species. Whether Bowers' specimen came from the Pliocene or Pleistocene is a matter of doubt.

Dr. Dall pronounced *C. tritonidea* near to *C. cassidiformis* Sowerby, and it may be one form of this latter variable species.

The young shells of this species are quite variable in regard to the prominence of the nodes, amount of angulation of the whorls, and the shape of the aperture. Any one not possessing a series showing the connection between the two extremes might think them different species. *C. vetusta* is probably a precursor of, if not identical with, *C. tritonidea.*

Rather rare in the upper San Pedro series of San Pedro. Found also in the Pleistocene at Barlow's ranch and at old irrigating ditch, Ventura. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Pleistocene.—Coyote Creek, Ventura County; San Pedro (Cooper): San Pedro; Ventura (Arnold).

Genus **Admete** *Moller*.

Shell oval, thin, diaphanous, covered by a thin epidermis; spire sharp; last whorl ventricose; aperture oval, feebly channeled in front, columella arcuated, obliquely truncated, with rudimentary plications; outer lip sharp.

Admete viridula Fabr. is a characteristic species.

198. **Admete gracilior** *Carpenter*.

PLATE VII, FIG. 4.

Cancellaria gracilior CPR., Pal. Cal., Vol. II, p. 50, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 23.

Shell small, ovate, thin; spire elevated, subacute; whorls six, rounded to subangular, crossed by numerous prominent, rounded ridges which reach their maximum prominence on the angle of the whorl; these ridges become nearly obsolete on the anterior part of the body-whorl; spiral sculpture consists of numerous fine ridges and furrows; suture deeply depressed, giving shouldered appearance to whorls; aperture ovate; outer lip thin, smooth; inner lip only slightly incrusted; columella obliquely truncated, and having two plications on inner side; slight umbilical slit; no canal.

Dimensions.—Long. 11 mm.; lat. 6.3 mm.; body-whorl 7.5 mm.; aperture 5.5 mm.; defl. 50 degrees.

A unique form, looking something like a small *Fusus robustus* with the canal gone. It is quite a variable species, one specimen showing a narrower spire and fewer, but more prominent ribs than the type, while still another showed more rounded whorls and less prominent ridges.

Found in the lower San Pedro series at Deadman Island. Also obtained from the Pleistocene at the bath-house, Santa Barbara; and at Port Los Angeles, near Santa Monica. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Oldroyd; Arnold): Santa Barbara (Carpenter; Arnold): Santa Monica (Arnold).

Family LIV. OLIVIDÆ.

Genus **Olivella** *Swainson*.

Shell small, polished; spire produced, acute; suture canaliculated; aperture narrow behind; enlarged anteriorly; columella plicated in front, callous posteriorly.

Olivella undatella is a characteristic species.

199. **Olivella biplicata** *Sowerby*.

Olivella biplicata SBY., Tank. Cat., App., p. 33, 1825. CPR., Brit. Assn. Rept., 1863, p. 661. H. & A. ADAMS, Gen. Rec. Moll., p. 146. GABB, Pal. Cal., Vol. II, p. 75, 1869. TRYON, Man. Conch., Vol. V, p. 87, Pl. XXXIV, fig. 58, 1883. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. KEEP, West Coast Shells, p. 40, fig. 20, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 212 (and varieties).

Shell small, subcylindrical; spire only slightly elevated; apex subacute; whorls five or six, flat, smooth, except for very fine incremental lines; suture appressed, very distinct; body-whorl convex, but nearly flat near outer lip; aperture elongate-triangular; outer lip thin, nearly straight; inner lip thickly incrusted, the incrustation forming quite a ridge; columella completely incrusted around lower portion, two prominent plications.

Dimensions.—Long. 17.7 mm.; lat. 9.6 mm.; body-whorl 15.7.; aperture 13.1 mm.; apical angle 90 degrees.

This species differs from *O. pedroana* in size and comparative width, and from *O. intorta* in having two plaits, a greater deflection, and in being much larger.

Common in the lower and upper San Pedro series, and Pliocene of the San Pedro region. Found also in the Pleistocene at Barlow's ranch and the old irrigating ditch, Ventura; at the bath-house, Santa Barbara, and at Spanish Bight and Pacific Beach, San Diego.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara; Ventura; San Diego (Arnold).

Pliocene.—Seven Mile House; Twelve Mile House; Kirker's Pass; San Diego well (Cooper): San Pedro (Arnold).

200. **Olivella intorta** *Carpenter.*

Olivella intorta CPR., Proc. Zool. Soc., 1856, p. 207. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. KEEP, West Coast Shells, p. 42, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 212, Pl. XIX, fig. 9.

Shell small, subovate; spire elevated, solid; whorls five, flat, smooth; suture appressed, very distinct; body-whorl ventricose, smooth; aperture long, narrow, widening anteriorly; outer lip thin; inner lip incrusted, incrustation thick, forming callus on body of middle whorl near aperture; columella with smooth incrustation over lower portion, and one prominent, sharp plait on lower side.

Dimensions.—Long. 11.7 mm.; lat. 6 mm.; body-whorl 9.7 mm.; aperture 7.2 mm.; defl. 60 degrees.

Distinguishable from *O. pedroana* by breadth, less elevated spire, greater deflection, and larger callus on upper part of inner lip; distinguishable from *O. biplicata* by single plait on columella, less deflection and smaller size.

Quite common in the Pliocene and Pleistocene of the San Pedro region; rare in upper San Pedro series at Los Cerritos. Found in the Pleistocene at Twenty-sixth Street and Pacific Beach, San Diego; and at Barlow's ranch and the old irrigating ditch, Ventura.

Living.—Santa Cruz to Lower California (Dall).

Pleistocene.—San Pedro; San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

Pliocene.—San Diego well (Dall).

201. Olivella pedroana *Conrad.*

Strephona pedroana CON., Pac. R. R. Rept., Vol. V, p. 327, Pl. VI, fig. 51, 1854.
Olivella bætica CPR., Brit. Assn. Rept., 1863, p. 661. GABB, Pal. Cal., Vol. II, p. 75, 1869. TRYON, Man. Conch., p. 71, Pl. XVII, figs. 28, 31, 34, 1883. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. KEEP, West Coast Shells, p. 42, fig. 21, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 212, Pl. XIX, fig. 7.

Shell small, elongate; spire elevated; apex acute; whorls five, flat, smooth; suture appressed, very distinct; aperture elongate-triangular; outer lip thin; inner lip callous; lower part of columella incrusted; columellar plication divided by median groove.

Dimensions.—Long. 12.9 mm.; lat. 5 mm.; body-whorl 9.4 mm.; aperture 7.2 mm.; defl. 40 degrees.

Distinguishable from *O. intorta* by double columellar plication, smaller callus, slenderer form, sharper apex and straighter outer lip; distinguishable from *O. biplicata* by slenderer form, smaller size, and more elevated spire.

Common in upper San Pedro series of Los Cerritos; rare in upper and lower San Pedro series, and Pliocene of San Pedro and vicinity. Found also in the Pleistocene at Spanish Bight and Pacific Beach, San Diego, and at Barlow's ranch, Ventura.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

Pliocene.—Seven Mile Beach; Twelve Mile House; Kirker's Pass; San Diego well (Cooper).

Family LV. MARGINELLIDÆ.

Genus Marginella *Lamarck.*

Shell ovately oblong to subcylindrical, smooth, polished, sometimes longitudinally ribbed; spire short, conical, or concealed; aperture narrow, elongated, obtuse or truncated in front; columella plicate; outer lip with a thick marginal varix, its inner margin smooth or crenulated.

Marginella globella Linn. is a characteristic species.

202. Marginella jewettii *Carpenter.*

Marginella jewettii CPR., Proc. Zool. Soc., 1856, p. 207; Brit. Assn. Rept., 1863, p. 661. TRYON, Man. Conch., Vol. V, p. 43, Pl. XII, fig. 57, 1883. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 249. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 1, 1890, p. 57. KEEP, West Coast Shells, p. 43, fig. 23, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 212, Pl. XIX, fig. 6.

Shell small, smooth, ovate-oblong; spire barely visible; aperture not extending full length of shell, narrow, elongated, obliquely truncated in front; outer lip thickened with marginal varix, its inner side smooth; columella with three prominent plications near anterior end, and lesser ones above.

Dimensions.—Long. 5 mm.; lat. 3 mm.; aperture 4.7 mm.

Specimens identified by Dr. Dall.

Found in the lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at Crawfish George's, San Pedro, and Deadman Island.

Living.—Monterey to San Pedro (Dall).

Pleistocene.—San Pedro (Cooper; Arnold).

Section *Volvarina Hinds.*

Shell small, pyriform, polished; spire elevated, but concealed by enamel; aperture not extending full length of shell; outer lip thin, with incurving flange; columella with sharp plaits.

203. **Marginella (Volvarina) varia** *Sowerby.*

PLATE IV, FIG. 9.

Volvarina varia SBY., CPR., Brit. Assn. Rept., 1863, p. 661. KEEP, West Coast Shells, p. 43, 1892.

Shell small, pyriform, smooth; spire elevated slightly, but concealed by enamel of surface; aperture not extending full length of body-whorl, narrow posteriorly, widening gradually anteriorly; outer lip thin, with a flange curved inward; columella with four sharp plaits.

Dimensions.—Long. 9 mm.; lat. 5 mm.; aperture 8 mm.

Specimens identified by Dr. Dall.

Found in all of the lower and upper San Pedro series localities in the vicinity of San Pedro. Found also in the Pleistocene at Twenty-sixth Street, San Diego. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Cooper): Cape St. Lucas; West Indies (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

Family LVI. MITRIDÆ.

Genus **Mitra** *Lamarck.*

Shell fusiform, thick; spire elevated; aperture small, narrow, notched in front; columella transversely, somewhat obliquely, plicate; outer lip thick, smooth within, without external varices.

Type, *Mitra episcopalis* Lam.

204. **Mitra maura** *Swainson.*

Mitra maura SWAIN., Proc. Zool. Soc., p. 193, 1835. CPR., Brit. Assn. Rept., 1863, p. 661. TRYON, Man. Conch., Vol. IV, p. 121, Pl. XXXVI, fig. 67, 1882. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 257. KEEP, West Coast Shells, p. 42, fig. 22, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 211.

Shell mitre-shaped; spire elevated; apex subacute; whorls five or six, only slightly convex, each appressed against antecedent whorl, forming a distinct suture; surface smooth, except for incremental lines; aperture long, narrow; outer lip thickened; inner lip not incrusted; columella with four distinct plaits, which increase in prominence posteriorly.

Dimensions.—Long. 56 mm.; lat. 18.5 mm.; body-whorl 37 mm.; aperture 25 mm.; defl. 30 degrees.

Found in the lower San Pedro series at San Pedro, and in the upper San Pedro series at Deadman Island, San Pedro and Crawfish George's.

Living.—Farallon Islands to San Diego; South America (Cooper).

Pleistocene.—Santa Barbara to San Diego; San Nicholas Island (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Mitromorpha** *A. Adams.*

Shell small, elongately fusiform; whorls flattened, with revolving liræ, and sometimes longitudinally plicate; aperture narrow; columella straight, slightly transversely lirate; lip acute, smooth within, scarcely sinuated posteriorly.

Mitromorpha gracilis Carpenter is a characteristic species.

205. **Mitromorpha filosa** *Carpenter.*

?Daphnella filosa CPR., Brit. Assn. Rept., 1863, p. 658.
Mitromorpha filosa CPR., KEEP, West Coast Shells, p. 55, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XIX, fig. 1.

Shell small, mitre-shaped; apex rounded; whorls six, flat, ornamented with several sharp, raised, revolving lines; suture impressed, distinct; aperture long, narrow, oblique; outer lip denticulate interiorly; inner lip smooth; columella spirally lined externally.

Dimensions.—Long. 8 mm.; lat. 3.6 mm.; body-whorl 6 mm.; aperture 5 mm.; defl. 55 degrees.

A shell from the Pleistocene shows transverse ridges on first four whorls, but these become obsolete below this. This transversely ridged specimen is intermediate between the typical *M. filosa* and *M. intermedia*. *M. aspera* is probably the type of the precursor of the three West Coast species mentioned, then in phylogenetic order would come *M. intermedia*, specimens like the ridged variety of *M. filosa*, and lastly typical *M. filosa*. The cancellate upper whorls of all the species except *M. filosa* show *M. aspera* to be the precursory form.

One specimen in lower San Pedro series of San Pedro.

Living.—Santa Barbara (Carpenter): San Pedro (Simpson).

Pleistocene.—San Pedro (Arnold).

206. **Mitromorpha intermedia**, sp. nov.

PLATE IV, FIG. 10.

Shell small, mitre-shaped; apex rounded; whorls six; slightly convex; whorls ornamented with about four equidistant, sharp, raised spiral lines, and numerous rounded, transverse ridges which are most prominent on angle of whorl; ridges are obsolete, or nearly so, on body-whorl; suture quite deeply impressed; aperture long, narrow, oblique; outer lip slightly arcuate anteriorly, smooth interiorly; inner lip smooth; columella spirally lined externally.

Dimensions.—Long. 9.5 mm.; lat. 3.9 mm.; body-whorl 6.5 mm.; aperture 4.5 mm.; defl. 36 degrees.

This species occupies a position nearly midway between *M. filosa* and *M. aspera*. It differs from the first in having distinct transverse ridges on the upper whorls, a smooth inner lip, a slightly slenderer form, and a more impressed suture; and differs from the second in having fewer transverse ridges, which are obsolete, or nearly so, on the body-whorl, a narrower aperture, a slenderer form and more numerous and sharper spiral lines. Pronounced a new variety of *filosa* by Dr. Dall. Its characteristics would ally it a little more readily with *M. aspera*, but it has enough distinctive features to separate it from both.

Rare in lower San Pedro series of Deadman Island.

Found in the Pleistocene at the bath-house, Santa Barbara. The specimen figured is the type, which was found in the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Living.—West Coast (?) (Dall).

Pleistocene.—San Pedro; Santa Barbara (Arnold).

Family LVII. FASCIOLARIIDÆ

Subfamily FUSINÆ.

Genus **Fusus** *Lamarck.*

Shell fusiform; spire long, acuminate, many-whorled; aperture oval, usually striate within; outer lip simple; columella smooth; no umbilicus; canal long and straight.

Fusus nicobaricus Lam. is a characteristic species.

207. **Fusus barbarensis** *Trask.*

PLATE IV, FIG. 15.

Fusus barbarensis TRASK, Proc. Cal. Acad. Sci., Vol. I, 1855, p. 41. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 240. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 217.
Fusus corpulentus (not of CONRAD, Wilkes' Expl. Exped., Vol. X, p. 728, Pl. XX, fig. 4, 1849) COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 26.
Fusus dupetithouarsi (*non* KIENER), COOPER, Bull. No. 4, Cal. St. Mining Bureau, Part 3, 1894, p. 26.

Shell of medium size, long, slender, fusiform, rather thin; whorls nine, evenly convex, crossed by about ten rather low, rounded ridges, which fade out toward sutures; body-whorl sometimes lacks these ridges, but in that case it generally has an irregularly, wavy surface ornamented with numerous sharp, raised spiral lines with sometimes smaller lines intercalated; suture deeply appressed; aperture subelliptical; outer lip thin, smooth margin, with prominent, internal spiral lines beginning just posterior to margin; inner lip incrusted, sometimes not covering the spiral sculpture of columella; columella long, nearly straight, except for curve backwards, spirally ridged; canal long, narrow, nearly straight.

Dimensions.—Long. 60 mm.; lat. 20 mm.; body-whorl 39 mm.; aperture, including canal, 31 mm.; canal 15 mm.; defl. 32 degrees.

Distinguishable from *F. robustus* and *F. rugosus* by much slenderer form, longer spire, more clear-cut spiral lines, and longer and straighter canal. This is the oldest form found in this locality. There is no doubt about the close relationship of the three species, *barbarensis*, *robustus* and *rugosus*, as the large series of each which the writer has had during the preparation of this paper shows forms nearly, if not quite, filling the gaps between the three types. *F. barbarensis* is probably the precursor of the other two forms, and although it occurs in the later horizons in which the other two species are the denominating types, still, judging by numbers, this form reached its maximum development in the upper San Pedro series.

Specimens identified by Dr. Dall.

Common in the Pliocene, rare in the lower San Pedro series of Deadman Island; one or two specimens found at each of Deadman Island, San Pedro, and Crawfish George's in the upper San Pedro series. The specimen figured is from the Pliocene at Deadman Island, and is now in the collection of Delos Arnold. This and several other species have been reported from the "Miocene of Deadman Island." Although the lowest horizon at Deadman Island is Miocene, still all of the fossils reported as occurring in the Miocene at that place come out of a Pliocene stratum which rests unconformably upon the Miocene.

Living—San Pedro (Oldroyd; Raymond).

Pleistocene.—Santa Barbara (Trask; Cooper): San Pedro (Arnold).

Pliocene—San Pedro (Arnold).

208. **Fusus luteopictus** *Dall.*

Fusus luteopictus DALL, "'Proc. Cal. Acad. Sci.,' 1877, p. 4." (Author's unauthorized reprint, issued March 19, 1877.)

Fusus ambustus GLD., CPR., Brit. Assn. Rept., 1863, p. 664 (pars.); (not of GOULD) (*fide* DALL.)

Fusus geniculus CONR., GABB, Pal. Cal., Vol. II, p. 71, 1869 (pars. syn. excl.) (*fide* DALL).

Fusus ambustus GLD., COOPER, Cal. Monterey Shells, Am. Jour. Conch., Vol. VI, p. 70; Geog. Cat., No. 787 (most Californian writers) (*fide* DALL).

Fusus luteopictus DALL, WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 217, Pl. XX, fig. 1.

Shell small, fusiform; whorls five, convex, crossed by nine rounded ridges which reach their maximum development on the middle of whorl; surface ornamented with three or four prominent spiral lines, with finer ones sometimes intercalated; suture appressed; aperture subovate; outer lip not thickened, with internal spiral lines; inner lip incrusted; columella short; canal very short, narrow.

Dimensions.—Long. 19 mm.; lat. 10 mm.; body-whorl 13.5 mm.; aperture, including canal, 10 mm.; canal 3 mm.; defl. 38 degrees.

Distinguishable by small size and very short canal.

Rare in the lower San Pedro series at Deadman Island; common in the upper San Pedro series at Crawfish George's, but rare in the same horizon at San Pedro, Deadman Island and Los Cerritos. Most of the specimens obtained came from Crawfish George's.

Living.—Farallon Islands to San Diego (Dall).

Pleistocene.—San Pedro (Arnold).

209. **Fusus robustus** *Trask.*

Fusus robustus TRASK, Proc. Cal. Acad. Sci., Vol. I, 1855, p. 41. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 241.

Fusus kobelti (not of DALL), of COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 240 (in part).

Shell of medium size, elongate-fusiform, thick; whorls about six, convex, crossed by eight or nine prominent rounded ridges which are most prominent on angle of whorl (these ridges are sometimes obsolete on the anterior part of the body-whorl); spiral sculpture consists of four to six prominent raised lines, with sometimes smaller lines intercalated; suture appressed, deep, distinct; aperture pyriform; outer lip smooth on inner edge, but with numerous spiral ridges further in; inner lip smooth; columella spirally ridged externally; canal rather short, narrow.

Dimensions.—Long. 34 mm.; lat. 14 mm.; body-whorl 22.5 mm.; aperture, including canal, 17 mm.; canal 5 mm.; defl. 40 degrees.

Distinguishable from *F. rugosus* by smaller size, heavier shell, lack of prominent angular appearance of whorls and ridges near posterior suture, less number of whorls and relatively shorter canal. Upon examining a large series of this species and of *F. rugosus* the writer has no hesitancy in separating these two forms of Trask's. Distinguishable from *F. kobelti* by deeper appressed suture, stronger, revolving ridges, narrower form, and lack of wavy sutural band on posterior edge of whorl. *F. robustus* is probably a precursor of *F. kobelti.* This species has been identified as *F. ambustus* by many West Coast conchologists, including Cooper and perhaps Carpenter. Specimens identified by Dr. Dall.

Found only in the upper San Pedro series; rather common at Old San Pedro. Found also in the Pleistocene at the bath-house, Santa Barbara.

Living.—Santa Barbara to San Diego (California State Museum).

Pleistocene.—Santa Barbara (Cooper; Arnold): San Pedro (Trask; Arnold).

210. **Fusus rugosus** *Trask.*

PLATE IV, FIG. 7.

Fusus rugosus TRASK, Proc. Cal. Acad. Sci., Vol. I, 1855, p 41. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 241.

Shell of medium size, elongate, fusiform, thin; whorls eight, convex, crossed by eight to eleven rounded ridges, which rise to greatest prominence on upper side of whorl; body-whorl ventricose and sometimes lacking transverse ridges on forward part; surface ornamented with several prominent raised lines, with fine lines sometimes intercalated; suture deeply appressed, wavy; aperture elliptical; outer lip thin, with interior spiral ridges extending nearly to rim; inner lip smooth; columella long, slightly twisted, spirally ridged; canal long, narrow, slightly curved.

Dimensions.—Long. 50 mm.; lat. 19 mm.; body-whorl 35 mm.; aperture, including canal, 28 mm.; canal 13 mm.; defl. 44 degrees.

The specimen described and figured is a small one. Some of the specimens are over 65 mm. in length.

Distinguishable from *F. robustus* by larger size, thinner shell, longer canal, more ventricose body-whorl, and greater development of transverse ridges on upper portion of whorl. Perhaps *F. rugosus* is the precursor of *F. robustus.* If so, then *robustus* is a degenerate form in so far as size and beauty go, for *rugosus* is truly a magnificent shell, while the former is small and much less attractive. This species has been identified as *F. ambustus*, and is so labeled in the State Museum collection at Berkeley. *F. ambustus* of Gould is a slenderer, longer pillared form from Central America.

Found only in the lower San Pedro series of Deadman Island. The shells in this horizon are beautifully preserved, this form especially being nearly always found in a perfect condition, and having a shell that in most cases is translucent. Rather rare. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (California State Museum).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold; Trask).

Genus **Pisania** *Bivona.*

Shell oblong; spire prominent; whorls smooth or spirally striated; canal very short; outer lip thickened and crenated.

Pisania pusio Linn. is a characteristic species.

211. **Pisania fortis** *Carpenter.*

Pisania fortis Cpr., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XVII, 1866, p. 277. Cooper, 7th Ann. Rept. Cal. St. Min.. 1888, p. 260.

Shell fusiform, short; spire elevated; apex subacute; whorls five or six, convex on upper whorls to angular on body-whorls; eight wave-like ribs, most prominent on the angle of the whorl; prominent sutural riblet on posterior margin of whorl; surface ornamented with three to five prominent, squarish, rough, revolving ridges, between which are finer raised lines; suture wavy, appressed, distinct; aperture pyriform; outer lip denticulated; umbilicus subperforate.

Dimensions.—Long. 49 mm.; lat. 29 mm.; body-whorl 38 mm.; aperture 25 mm.; defl. 58 degrees.

This species resembles some specimens of *Purpura crispata*, but is a lighter shell, and the sculpture is entirely different. Originally described from a specimen from the Pleistocene of Santa Barbara. It has never been found living.

Rare in the upper San Pedro series of San Pedro and Deadman Island; two specimens found. Found in the Pleistocene at Pacific Beach, San Diego.

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego (Arnold).

Family LVIII. BUCCINIDÆ.

Genus **Chrysodomus** *Swainson.*

Shell fusiform, ventricose; spire elevated; whorls rounded; covered with a horny epidermis; apex papillary; aperture oval; canal short; inner lip simple, smooth.

Chrysodomus antiqua Linn. is a characteristic species.

212. Chrysodomus rectirostris *Carpenter*.

PLATE VII, FIG. 7.

Chrysodomus rectirostris CPR., Brit. Assn. Rept., 1863, p. 664; Proc. Phil. Acad. Nat. Sci., 1865, p. 64. TRYON, Man. Conch., Vol. II, p. 131, Pl. LIII, fig. 348, 1881.

Shell small, turreted, slender; apex acute; whorls nine or ten, slightly convex, with about fourteen rounded, transverse ridges reaching from suture to suture; ridges follow direction of lines of growth, which are convex anteriorly; spiral sculpture consists of numerous fine furrows; suture impressed, distinct; body-whorl slightly angulated at base; aperture elliptical; outer lip thin, bulging above canal; inner lip smooth, incrusted; columella long, straight, narrow, smooth on inner part; canal long, straight, narrow.

Dimensions.—Long. 28 mm.; lat. 7 mm.; body-whorl 14.5 mm.; aperture, including canal, 11.5 mm.; canal 5 mm.; defl. 22 degrees.

This species looks something like a *Pleurotoma*, but may be distinguished by the straight canal and almost flat whorls. Carpenter's description in the British Association Report for 1863 is misleading. In describing this species he says the shell is "small, white, smooth, with straight canal." Why he uses "smooth" in describing such a decidedly sculptured form is not easy to understand. Several specimens of this species were identified from Carpenter's type by Dr. Dall.

Rare in the Pliocene and lower San Pedro series at Deadman Island, and in the upper San Pedro series at Crawfish George's. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Puget Sound (Carpenter).

Pleistocene.—San Pedro (Arnold).

213. Chrysodomus tabulatus *Baird*.

PLATE VII, FIG. 6.

Chrysodomus tabulatus BAIRD, Proc. Zool. Soc., 1863, p. 66. CPR., Brit. Assn. Rept., 1863, p. 663; Nat. in British Columbia, Vol. II, p. 356. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 235.

Neptunea tabulata BAIRD, GABB, Pal. Cal., Vol. II, p. 71, 1869. TRYON, Man. Conch., Vol. II, p. 121, Pl. XLIX, fig. 286, 1881.

Shell large, fusiform; spire elevated; apex subacute; whorls eight, sharply angulated and keeled above, forming a rimmed, spiral table; surface ornamented with revolving ridges of alternating size; suture very deeply impressed; aperture pyriform; outer lip thin, smooth; inner lip incrusted; canal long, narrow, curved backwards; columella twisted, spirally ridged.

Dimensions.—Long. 80 mm.; lat. 34 mm.; body-whorl 55 mm ; aperture, including canal, 42 mm.; canal 19 mm.; defl. 44 degrees.

Rather common in Pliocene; rare in lower San Pedro series of Deadman Island and San Pedro. Found also in the Pleistocene at the bluff west of the bath-house, Santa Barbara, and at the old irrigating ditch north of Ventura. The specimen figured was from the Pliocene, Deadman Island, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to Catalina Island (Cooper).

Pleistocene.—San Pedro; Santa Barbara; Ventura (Arnold).

Pliocene.—Eagle Prairie; Twelve Mile House; San Fernando; Santa Barbara (Cooper); San Pedro (Cooper; Arnold).

214. **Chrysodomus**, sp. indet.

Two poorly preserved, undeterminable species; both fusiform, one with rounded whorls, the other slightly tabulated on upper part; fine spiral sculpture on both. These specimens have the shape of *C. dirus.* They correspond quite closely to the descriptions of some of the living species which now inhabit boreal waters.

Found in the Pliocene of Deadman Island.

Pliocene.—San Pedro (Arnold).

Genus **Siphonalia** *A. Adams.*

Shell ovately fusiform, sometimes variegated in coloring; rather thin; epidermis very thin, fugacious; last whorl ventricose, shouldered, usually nodosely plicate and spirally ribbed; aperture oval; outer lip thin; columella smooth; canal rather short, twisted.

Siphonalia nodosa Mart. is a characteristic species.

215. **Siphonalia kellettii** *Forbes.*

PLATE IV, FIG. 5.

Siphonalia kellettii FORBES, Proc. Zool. Soc., 1850, p. 274, Pl. X, fig. 10. CPR., Brit. Assn. Rept., 1863, p. 663. TRYON, Man. Conch., Vol. III, p. 134, Pl. LIV, fig. 352. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. DALL, Trans. Wagner Inst. Sci., Vol. III, Part. I, 1890, p. 122. KEEP, West Coast Shells, p. 22, 1892.

Shell large, fusiform; spire elevated; apex subacute; whorls seven or eight, angulated anterior to middle with eight to ten prominent nodes on angle; concave near posterior margin, where it is appressed against the antecedent whorl; numerous fine, deep grooves furnish the spiral ornamentation; suture appressed, wavy; aperture ovate; outer lip not thickened; inner lip incrusted; columella twisted; umbilicus subperforate; canal long, narrow, curved back.

Dimensions.—Long. 114 mm.; lat. 59 mm.; body-whorl 80 mm.; aperture 37 mm.; canal 22 mm.; defl. 44 degrees.

Often brought up alive in the nets of fishermen at San Pedro, but rarely found fossil. Found in the upper San Pedro series at San Pedro, Los Cerritos, and Crawfish George's. Found also in the Pleistocene at Pacific Beach, San Diego. The specimen figured was obtained in the upper San Pedro series at San Pedro, and is now in the private collection of Delos Arnold.

Living.—Santa Barbara to San Diego; Japan (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Genus **Macron** *H. & A. Adams.*

Shell ovate, solid, with a thick epidermis; spire elevated; columella wrinkled, with a callosity at the upper part; outer lip thin, with a small tooth anteriorly.

Type, *Macron kellettii* A. Ads.

216. **Macron kellettii** *A. Adams.*

Pseudoliva kellettii A. Ad., Proc. Zool. Soc., 1853, p. 185.
Macron kellettii A. Ad., Cpr., Brit. Assn. Rept., 1863, p. 664. Tryon, Man. Conch., Vol. III, p. 214, Pl. LXXXII, fig. 477, 1881. Keep, West Coast Shells, p. 21, 1892. Cooper, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 27.

Shell ovate, solid, subperforate; spire prominent; whorls rounded; suture canal-like; last whorl spirally sulcated; aperture oval; columella callous posteriorly, anterior portion produced and flexed; posterior part of lip bent, anterior part dentate. Canal a mere notch. Average length about 25 mm.

One specimen in upper San Pedro series of San Pedro.

Living.—Lower California (Keep): Catalina Island to Lower California (Cooper).

Pleistocene.—San Pedro (Arnold): San Joaquin Bay, Orange County (Bowers).

Pliocene.—Ventura County (Bowers).

217. **Macron lividus** *A. Adams.*

Macron lividus A. Ad., Cpr., Brit. Assn. Rept.. 1863, p. 664. Keep, West Coast Shells, p. 20, fig. 2, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 216.

Shell small, ovate, solid; spire elevated; apex subacute; whorls five, evenly convex, smooth; suture distinct; aperture ovate; outer lip sharp and curved; inner lip short and bent; columella with a strong fold near the top of the aperture.

Dimensions.—Long. 19 mm.; lat. 10 mm.; body-whorl 14 mm.; aperture 10 mm.

This species is characterized by its smooth surface and small size. One specimen found in the upper San Pedro series at the lumber yard, San Pedro.

Living.—San Pedro (Williamson): San Diego to Lower California (Carpenter).

Pleistocene.—San Pedro (Arnold).

Family LIX. NASSIDÆ.

Genus **Nassa** *Lamarck.*

Shell ovate, ventricose; body-whorl variously sculptured; aperture ovate, with a short, reflected, truncated, anterior canal; inner lip smooth; often widely spread over with enamel, with a posterior callosity or a blunt dentiform; outer lip dentated, internally crenulated.

Nassa mutabilis Linn. is a characteristic species.

218. Nassa californiana *Conrad.*

PLATE IV, FIG. 3.

Schizopyga californiana CON., Proc. Phil. Acad. Nat. Sci., 1856, p. 315; Pac. R. R. Rept., Vol. VI p. 69, Pl. II, fig. 1, 1857.
Schizopyga californica CON., TRYON, Man. Conch., Vol. IV, p. 55, Pl. III, fig. 32, 1882.
Nassa californiana CON., DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 177. COOPER, Bull. No. 9, Cal. St. Min. Bureau, Part 3, 1894, p. 29.
Nassa fossata var., GABB, Pal. Cal., Vol. II, pp. 47, 74, 1869.

Shell large, conical; whorls seven, convex, ornamented with about thirteen prominent, rounded, posteriorly sloping, transverse ribs and four or five slightly less prominent sharp, revolving ridges; the transverse ridges tend to become less prominent on the anterior part of the body-whorl; suture deeply impressed, distinct; aperture subovate; outer lip thin and denticulated by ends of internal revolving ridges; inner lip slightly incrusted; columella short, twisted, spirally and longitudinally ornamented, and deeply grooved next to body-whorl; anterior sinus very short, broad, recurved.

Dimensions.—Long. 37 mm.; lat. 20.5 mm.; body-whorl 24 mm.; aperture 16.5 mm.; defl 48 degrees.

The most beautiful and one of the largest of the Pleistocene *Nassas.* Easily distinguishable by the ornamentation and size.

Rare in the upper San Pedro series, except at one place in the bluff just north of the town of San Pedro, where quite a few very fine specimens have been found; also found in the Pliocene and lower San Pedro series at Deadman Island; and in the upper San Pedro series at Los Cerritos, Deadman Island, and Long Beach. Found also in the Pleistocene at Barlow's ranch, Ventura; and at Pacific Beach, San Diego. The specimen figured is from the upper San Pedro series of San Pedro; and is now in the private collection of Delos Arnold.

Living.—Drake's Bay to Cedros Island, Lower California (Cooper).

Pleistocene.—San Pedro; Ventura; San Diego (Arnold).

Pliocene.—San Pedro (Arnold).

Miocene.—Santa Clara County (Cooper).

219. Nassa cerritensis, sp. nov.

PLATE IV, FIG. 1.

Shell small, conical; spire elevated; apex subacute; whorls eight, slightly convex, crossed by seven to ten prominent, rounded ridges which are less prominent near the suture; spiral sculpture consists of nine to eleven sharp, raised lines; three upper whorls have a cancellate appearance; suture appressed, wavy; aperture ovate; outer lip thickened by denticulated ridge on inner side; inner lip smooth, incrusted, the incrustation completely covering the spiral sculpture internally; columella twisted, spirally sculptured, with deep groove next to body-whorl; canal short, broad, recurved.

Dimensions.—Long. 30 mm.; lat. 14.5 mm.; body-whorl 18 mm.; aperture 11 mm.; defl. 30 degrees.

This species varies much, especially in deflection and in the number of transverse ridges. The deflection of the upper whorls is sometimes as high as 60 degrees, while that of the lower whorls would be about one-half of that. Some of the adult shells also show a deflection of 50 degrees. The robust shells as a rule show more transverse ridges than the slenderer forms. Distinguishable from var. *cooperi* by less angulated whorls and ridges, less impressed suture, greater deflection of upper whorls, and larger size. The robust form somewhat resembles *N. californiana*, but is distinguishable from that species by its appressed, rather than impressed suture, less prominence of spiral lines, and smaller size. Dr. Dall pronounces this species a precursor of *N. cooperi*.

Rather common at Los Cerritos, where the type was found. One or two specimens found in the upper San Pedro series at San Pedro, Long Beach, and Crawfish George's. Found also in the Pleistocene at Spanish Bight, San Diego. The specimen figured is the type, which came from the upper San Pedro series at Los Cerritos, and is now in the United States National Museum.

Pleistocene.—San Pedro; San Diego (Arnold).

220. Nassa fossata *Gould.*

Buccinum fossatum GLD., Proc. Bost. Soc. Nat. Hist., 1850, p. 152. OTIA, Conch., p. 67, 1862.
Nassa fossata GLD., H. & A. ADAMS, Gen. Rec. Mollusca. CPR., Brit. Assn. Rept., 1863, p. 662. GABB, Pal. Cal., Vol. II, p. 74, 1869. TRYON, Man. Conch., Vol. IV, p. 55, Pl. XVII, figs. 316, 318, 1882. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. KEEP, West Coast Shells, p. 36, fig. 16, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 212.

Shell small, conical; spire elevated; apex subacute; whorls seven, convex; body-whorl ventricose; ornamentation of fourth and fifth whorl consists of five or six strong, nodose, spiral ridges which increase in number by intercalation on the lower whorls; the prominence of the nodes varies inversely with the number of ridges, the ridges on the body-whorl being nearly smooth and alternating large and small; the ridges near the angle of the whorl reach the greatest prominence; suture deeply impressed, distinct; aperture ovate; outer lip thickened and denticulated by ends of revolving internal ridges; inner lip incrusted, the incrustation spreading over part of body-whorl and columella; columella short, curved, spirally striated, and grooved deeply next to body-whorl; anterior sinus short, broad, recurved.

Dimensions.—Long. 29 mm.; lat. 17 mm.; body-whorl 21 mm.; aperture, including canal, 14.5 mm.; defl. 50 degrees.

The adolescent shell of this species resembles *N. perpinguis*, but may be distinguished by the greater convexity of the body-whorl, greater deflection, and general more solid appearance. The adult shells are characterized by their general solid appearance, great deflection, and the great difference in sculpture between the upper and lower whorls.

Found in the Pliocene at Deadman Island; in the lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at all of the localities in the vicinity of San Pedro. Found also in Pleistocene at Spanish Bight and Pacific Beach, San Diego; and at old irrigating ditch and Barlow's ranch, Ventura. The specimens of this species found at Crawfish George's are characterized by their large size and elevated spire, with deeply impressed suture.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

Pliocene.—Danger Creek; Santa Rosa; Soquel, Santa Cruz County; San Diego well (Cooper): San Pedro (Arnold).

Miocene.—Martinez; Walnut Creek; Griswold's, San Benito County; Foxin's, Santa Barbara County (Cooper).

221. **Nassa insculpta** *Carpenter.*

Nassa insculpta CPR., Brit. Assn. Rept., 1863, p. 662; Proc. Cal. Acad. Sci., Vol. III, 1866, p. 223. TRYON, Man. Conch., Vol. IV, p. 38, Pl. XII, fig. 154, 1882; (not of COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253). WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 212, Pl. XXIII, fig. 6.

Shell small, conical; spire elevated; apex subacute; whorls seven, nearly flat, but obliquely truncated near margin; sculpture consists of numerous fine, spiral furrows, which are most prominent on lower portion of body-whorl; four upper whorls have prominent transverse ridges; aperture subquadrate; outer lip thickened by a slightly denticulated ridge; inner lip incrusted slightly, but spiral ornamentation shows through the incrustation; columella short and separated from body-whorl by deep, narrow groove; canal short, broad, curved.

Dimensions.—Long. 20 mm.; lat. 11 mm.; body-whorl 12.8 mm.; aperture, including canal, 9 mm.; defl. 38 degrees.

Distinguishable by lack of any but spiral ornamentation on lower whorls. A specimen in the State Museum collection at Berkeley labeled *N. insculpta* is not the species, but is close to *N. versicolor* var. *hooveri.* This is probably the specimen upon which Cooper bases his report of the occurrence of *N. insculpta* at Santa Barbara. Rare in upper San Pedro series of San Pedro; one specimen.

Living.—Catalina Island (Cooper; Raymond).

Pleistocene.—San Pedro (Williamson; Arnold).

222. **Nassa mendica** *Gould.*

Nassa mendica GLD., Proc. Bost. Soc. Nat. Hist., 1850, p. 155. Wilkes' Expl. Exped., Vol. XII, p. 263, Pl. XIX, fig. 331, 1852. OTIA, Conch., p. 70, 1862. CPR., Brit. Assn. Rept., 1863, p. 662; =*M. woodwardi* FBS.; =*N. gibbsii* COOPER (*fide* TRYON, Man. Conch., Vol. IV, p. 56, Pl. XVII, figs. 320-323, 1882). GABB, Pal. Cal., Vol. II, p. 74, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. KEEP, West Coast Shells, p. 37, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.

Shell small, conical; spire elevated; apex acute; whorls seven, convex; ornamented with a varying number of transverse ridges and a few less prominent spiral ridges; suture deeply impressed, distinct; aperture subquadrate; outer lip thin, smooth on edge, but denticulated remote from margin; inner lip incrusted; columella curved, spirally striated, and separated from body-whorl by deep groove; canal short, recurved.

Dimensions.—Long. 18.5 mm.; lat. 8 mm.; body-whorl 11 mm.; aperture, including canal, 7.5 mm.; defl. 38 degrees.

A species varying principally in the number and prominence of transverse ridges. Distinguishable from *N. perpinguis* by acuteness of spire.

Found in all of the fossiliferous formations at all of the localities in the vicinity of San Pedro. *N. mendica* is much rarer than the variety *cooperi*. Found in the Pleistocene at the bath-house, Santa Barbara; at Barlow's ranch, and the old irrigating ditch, Ventura; and at Spanish Bight and Pacific Beach, San Diego.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara; Ventura; San Diego (Arnold).

Pliocene.—Kirker's Pass; Twelve Mile House, San Mateo County; San Diego well (Cooper): San Pedro (Arnold).

223. Nassa mendica *Gould*, var. cooperi *Forbes*.

Nassa cooperi FBS., Proc. Zool. Soc., 1850, p. 273, Pl. XI, fig. 4. CPR., Brit. Assn. Rept., 1863, p. 662. GABB, Pal. Cal., Vol. II, p. 74, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. KEEP, West Coast Shells, p. 37, fig. 18, 1892.

Nassa mendica var. *cooperi* FBS., TRYON, Man. Conch., Vol. IV, p. 56, Pl. XVII, figs. 322, 323, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.

Shell like *N. mendica*, except that the transverse ridges are more prominent and less numerous. Mutations occur between the extreme *N. mendica* with latticed ornamentation consisting of equally prominent spiral and transverse ridges, and the extreme *N. cooperi* with only six large, transverse ribs.

More common than the typical *N. mendica*. Found in the lower and upper San Pedro series and Pliocene of the San Pedro region. Found in the Pleistocene at Pacific Beach, San Diego.

Living.—Sitka to San Diego (Cooper): Catalina Island (Stearns).

Pleistocene—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Stearns; Arnold).

Pliocene.—Kirker's Pass; Twelve-mile House, San Mateo County; San Diego well (Cooper): San Pedro (Arnold).

224. Nassa perpinguis *Hinds*.

Nassa perpinguis HDS., Voyage Sulphur, p. 36, Pl. IX, figs. 12, 13, 1844. CPR., Brit. Assn. Rept., 1863, p. 662; GABB, Pal. Cal., Vol. II, pp. 47, 75, 1869. TRYON, Man. Conch., Vol. IV, p. 56, Pl. XVII, fig. 319, 1882. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. KEEP, West Coast Shells, p. 38, fig. 19, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.

Nassa interstriata, CON., Pac. R. R. Rept., Vol. V, p. 327, Pl. VI, fig. 49, 1856.

Shell small, conical; spire elevated; apex subacute; whorls seven, convex, abruptly truncated at posterior margin, forming a spiral table; ornamentation consists of sharp, spiral ridges with slightly wider interspaces, and posteriorly sloping transverse ridges, the whole giving a decidedly cancellate appearance to the surface; suture deeply impressed, distinct; aperture subovate; inner portion of aperture ridged by spiral sculpture; outer lip thin; inner lip thinly incrusted; columella twisted and spirally ornamented; groove on upper part of columella prominent; canal short, curved.

Dimensions.—Long. 23 mm.; lat. 12.3 mm.; body-whorl 15 mm.; aperture, including canal, 11 mm.; defl. 40 degrees.

The transverse ornamentation is the most prominent in the upper whorls, while in the later ones the spiral ridges are the most important. On the body-whorl the tranverse ridges sometimes become nearly obsolete, being represented only by lines of growth.

Common in the upper and rare in the lower San Pedro series at San Pedro and vicinity. Also found in the Pliocene at Deadman Island and Timm's Point. Found in the Pleistocene at Spanish Bight and Pacific Beach, San Diego; and at the old irrigating ditch and Barlow's ranch, Ventura.

Living.—San Francisco to San Diego; Lower California (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

Pliocene.—San Diego well (Dall): San Pedro (Arnold).

Miocene.—Santa Monica and Aliso Creek, Los Angeles County (Cooper).

225. **Nassa tegula** *Reeve.*

Nassa tegula RVE., Icon. Conch., *Nassa*, No. 98, Pl. XV, 1853. CPR., Brit. Assn. Rept., 1863, p. 662. GABB, Pal. Cal., Vol. II, p. 74, 1869. TRYON, Man. Conch., Vol. IV, p. 39, Pl. XIII, figs. 166, 167, 1882. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. KEEP, West Coast Shells, p. 37, fig. 17, 1892. DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.

Shell small, conical; spire elevated; apex subacute; whorls five, slightly angulated at middle, with nine or ten prominent transverse ridges most prominent on angular part of whorl; these ridges are sometimes divided by spiral grooves into two or more nodes; suture impressed, distinct; aperture subquadrate; outer lip thickened by a row of elongated denticles; inner lip smooth and incrusted, the incrustation spreading over the columella and the front of the shell like an apron; a rather shallow groove separates the lower portion of columella from body-whorl; canal very short.

Dimensions.—Long. 11 mm.; lat. 7 mm.; body-whorl 7.9 mm.; aperture, including canal, 5 mm.; defl. 58 degrees.

The most robust of the *Nassas* found in this locality. Distinguishable by the prominence of the incrustation on the inner lip. Dr. Dall says that this species is close to *N. vibex* of the Atlantic coast.

Rare in the upper San Pedro series at San Pedro, Los Cerritos, Long Beach, Deadman Island, and Crawfish George's; also occasionally found in the lower San Pedro series at Deadman Island and San Pedro. Found also in the Pleistocene at Twenty-sixth Street and Spanish Bight, San Diego.

Living.—Santa Barbara to San Diego; Lower California (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

226. **Nassa versicolor** *C. B. Adams*, var. **hooveri**, var. nov.

PLATE IV, FIG. 6.

Nassa versicolor C. B. AD., Panama Cat., p. 66, 1852. TRYON, Man. Conch., Vol. IV, p. 50, Pl. XV, figs. 270–272, 275, 1882.

Shell small, conical; spire not highly elevated; apex subacute; whorls six, slightly convex, crossed by fifteen prominent rounded ribs which bend slightly forward on the upper whorls, and are abruptly truncated at the sutures; on the body-whorl these ribs are concave anteriorly and become obsolete on the lower portion of the whorl; ribs on the upper whorls are of uniform size for their full length; suture deeply impressed, distinct; spiral ornamentation consists of eleven to thirteen grooves, which extend to base on body-whorl; columella extended, plication on inner side, and deep, narrow groove around it at base of body-whorl; outer lip thickened by a prominent, smooth ridge on the inner side; inner lip incrusted, the spiral sculpture, however, showing through the incrustation; canal short, broad, with effuse lips.

Dimensions.—Long. 14.5 mm.; lat. 9 mm.; body-whorl 10 mm.; aperture, including canal, 7 mm.; defl. 54 degrees.

A unique form for this locality; somewhat resembles *N. tegula* in shape, but easily distinguishable from that species by the sculpture. Pronounced a variety of *N. versicolor* Adams, by Dr. Dall. *N. versicolor* is found in the southern fauna, its habitat being Panama to Mazatlan according to Tryon.

Rare in upper San Pedro series of San Pedro; two specimens found, one a junior. The specimen figured is the type, which was obtained from the upper San Pedro series of San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Family LX. COLUMBELLIDÆ.

Genus **Columbella** *Lamarck.*

Shell strombiform or obovate, smooth or longitudinally or tranversely ribbed; internal lip excavated in the middle, crenulated or denticulated; outer lip inflected and internally thickened and crenulated in the middle.

Columbella mercatoria Lam. is a characteristic species.

227. **Columbella solidula** *Reeve*, var. **præcursor**, var. nov.

PLATE X, FIG. 4.

Columbella solidula RVE., Conch. Icon., Vol. XI, Pl. XXIV, fig. 149, 1859. TRYON, Man. Conch., Vol. V, p. 147, Pl. LII, figs. 92 and 93, 1883.

Shell small, broadly fusiform; spire elevated; apex rounded; whorls seven, only slightly convex, slightly shouldered above, smooth; body-whorl two-thirds length of shell, with row of nodes on shoulder, each node being the termination of a faint transverse ridge which becomes obsolete on lower portion of whorl; columella with spiral sulcations on exterior; aperture rhomboidal, narrow; outer lip thickened internally by row of prominent teeth; inner lip smooth; canal short, recurved.

Dimensions.—Long. 14.5 mm.; lat. 6.5 mm.; body-whorl 10 mm.; aperture, including canal, 7.5 mm.; canal 1 mm.; defl. 42 degrees.

This unique species is distinguishable by its smooth upper whorls, and sculptured body-whorl. Pronounced a variety of *C. solidula* Rve. by Dr. Dall.

The shell of which this form is a variety is found living on the coast of Ecuador, South America. The type is the only specimen that has been found in the upper San Pedro series at San Pedro; it is figured, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Subgenus **Anachis** *H. & A. Adams.*

Shell oval-fusiform, longitudinally ribbed; spire elevated; aperture narrow; columella straight; outer lip nearly straight, crenulated within.

Anachis rugosa Sowerby is a characteristic species.

228. **Columbella (Anachis) minima**, sp. nov.

PLATE IX, FIG. 8.

Shell small, resembles a young *Amphissa corrugata* but much slenderer; surface sculptured by numerous transverse ridges and fine spiral sulcations; whorls six, shouldered above as in *Amphissa versicolor;* aperture subquadrate; outer lip nearly straight; pillar straight, spirally striated.

Dimensions.—Long. 6 mm.; lat. 2.4 mm.; body-whorl 3.5 mm.; aperture 2.2 mm.; defl. 28 degrees.

Distinguishable from *Amphissa corrugata* by slenderer form, more shouldered whorls and less wavy transverse ridges. Pronounced a new species of *Anachis* by Dr. Dall.

Type from upper San Pedro series of San Pedro; rare. The specimen figured is the type, which is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Subgenus **Æsopus** *Gould.*

Shell fusiform, gibbous, broadly truncate in front; aperture lunate, with a posterior callous on the body; columella smooth, vitreous; suture abnormally arcuate near the aperture.

Type, *Æsopus japonicus* Gould.

229. **Columbella (Æsopus) chrysalloidea** *Carpenter.*

PLATE V, FIG. 6.

Amycla chrysalloidea CPR., Brit. Assn. Rept., 1863, p. 612; Proc. Cal. Acad. Sci., Vol. III, 1864, p. 223.

Columbella chrysalloidea CPR., TRYON, Man. Conch., Vol. V, p. 135, Pl. L, fig. 42, 1883.

Astyris chrysalloidea CPR., KEEP, West Coast Shells, p. 36, 1892.

Columbella (Æsopus) chrysalloidea CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.

Shell small, with general elongate-elliptical outline, or chrysalis-shaped; spire elevated, subacute; whorls six, very slightly convex; surface marked by delicate spiral ridges and furrows;

aperture ovate; canal short; outer lip thickened by several longitudinally elongate denticles on inner side; inner lip curved, smooth; spiral ornamentation prominent on lower portion of columella.

Dimensions.—Long. 8.2 mm.; lat. 3 mm.; body-whorl 5.5 mm.; aperture 3.4 mm.; defl. 44 degrees.

Rare in the lower San Pedro series at Deadman Island and San Pedro; not uncommon in the upper San Pedro series at San Pedro. Found also in the Pleistocene at Twenty-sixth street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—San Pedro to San Diego (Cooper).

Pleistocene.—San Pedro; San Diego (Arnold).

230. **Columbella (Æsopus) oldroydi**, sp. nov.

PLATE VI, FIG. 7.

Shell small, slender, fusiform; spire elevated; apex rounded; whorls seven, convex; first three whorls smooth, remainder, with exception of body-whorl, ornamented with about eighteen transverse ridges and two or three rather indistinct spiral grooves, the whole giving a cancellate appearance to the surface; on the body-whorl the transverse and spiral sculpture are of about equal prominence, the transverse sculpture being more subdued than on the whorls above it; suture quite deeply impressed; aperture narrow, elliptical; pillar truncated anteriorly; outer lip smooth, thin; inner lip smooth.

Dimensions.—Long. 9 mm.; lat. 2.6 mm.; body-whorl 5 mm.; aperture 3 mm.; defl. 24 degrees.

Distinguishable from *A. chrysalloidea* by slenderer form, prominently sculptured surface, deeper suture, and smooth inner lip. Pronounced a new species by Dr. Dall.

Lower San Pedro series at Deadman Island; rare. The specimen figured is the type, and is now in the collection of Mrs. Oldroyd.

Pleistocene.—San Pedro (Arnold).

Subgenus **Astyris** *H. & A. Adams.*

Shell oval-fusiform, smooth or transversely striated; aperture oval; inner lip smooth, not callous; outer lip sinuous posteriorly, crenulated within.

Astyris clausiliaforme Kiener is a characteristic species.

231. **Columbella (Astyris) californiana** *Gaskoin.*

PLATE X, FIG. 9.

Columbella (Astyris) californiana GASK., Proc. Zool. Soc., 1851, p. 12.
Columbella californiana GASK., CPR., Brit. Assn. Rept., 1856, p. 341.

This species resembles *A. gausapata* quite closely, but differs from it in the following respects: it is slightly broader, has more swelling whorls, more prominent spiral lines on the lower part of the body-whorl, does not have the overlapping appearance of the whorls at the suture as much as in *A. gausapata*, has a less heavy shell, and has a less glossy surface. Specimen identified by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island, also found in the lower San Pedro series at San Pedro. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Carpenter).

Pleistocene.—San Pedro (Oldroyd; Arnold).

232. Columbella (Astyris) gausapata *Gould.*

PLATE X, FIG. 8.

Columbella gausapata GLD., Proc. Bost. Soc. Nat. Hist., 1850, p. 170; Wilkes' Expl. Exped., Vol. XII, p. 267, Pl. XIX, fig. 337, 1852.

Nassa pedroana CON., Pac. R. R. Rept., Vol. V, p. 327, Pl. VI, fig. 48, 1856.

Amycla gausapata GLD., CPR., Brit. Assn. Rept., 1863, p. 662. GABB, Pal. Cal., Vol. II, p. 76, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 229.

Astyris gausapata GLD., KEEP, West Coast Shells, p. 35, fig. 15, 1892.

Columbella (Astyris) gausapata GLD., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.

Shell small, rather heavy; spire elevated; apex acute; whorls seven, slightly convex; body-whorl ventricose, slightly angulated; whorls smooth except for delicate incremental lines; suture depressed, distinct; columella recurved and striated on outside with faint spiral ridges and grooves; aperture elongate-ovate; canal prominent, slightly curved; outer lip thickened with a row of spirally elongate denticles; inner lip smooth.

Dimensions.—Long. 11 mm.; lat. 5 mm.; body-whorl 7 mm.; aperture (not including canal) 3 mm. × 1.9 mm.; defl. 35 degrees.

Distinguishable from *C. californiana* by much longer canal, thicker shell, and more prominent denticulation of outer lip; distinguishable from *C. tuberosa* by broader spire and less angulated body-whorl; distinguishable from var. *carinata* by lack of keel, and slenderer spire. Specimens identified by Dr. Dall.

Found in all of the formations at all of the localities in the vicinity of San Pedro. Found also in the Pleistocene at the bath-house, Santa Barbara; at Barlow's ranch and the old irrigating ditch, Ventura; and at Twenty-sixth Street and Pacific Beach, San Diego. Much rarer than var. *carinata*. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Alaska to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; Santa Barbara; San Diego (Arnold).

Pliocene.—Kirker's Pass (Cooper).

233. Columbella (Astyris) gausapata *Gould*, var. carinata *Hinds*.

PLATE X, FIG. 10.

Columbella carinata HDS., Voyage Sulphur, p. 39, Pl. X, figs. 15, 16, 1844. CPR., Brit. Assn. Rept., 1863, p. 662. TRYON, Man. Conch., Vol. V, p. 116, Pl. XLVII, figs. 35-39, 1883. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213.
Amycla carinata HDS., GABB, Pal. Cal., Vol. II, p. 76, 1869.
Astyris gausapata var. *carinata* HDS., KEEP, West Coast Shells, p. 35, 1892.

Shell like *A. gausapata*, except that it has a distinct keel on the upper part of the whorl. A large series of shells shows mutations between the typical *gausapata* and this variety. An extreme keeled form gives the following dimensions: Long. 8 mm.; lat. 4.1 mm.; body-whorl 5 mm.; aperture 3.5 mm.

Common in all of the formations at all of the localities in the vicinity of San Pedro; much commoner than *C. gausapata*. Found also in the Pleistocene at the old irrigating ditch north of Ventura; at bath-house, Santa Barbara; and at Spanish Bight, San Diego.

The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Pedro; Ventura; Santa Barbara; San Diego (Arnold).

234. Columbella (Astyris) tuberosa *Carpenter*.

PLATE X, FIG. 7.

Amycla tuberosa CPR., Brit. Assn. Rept., 1863, p. 662; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 398. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 229.
Astyris tuberosa CPR., STEARNS, Proc. Cal. Acad. Sci., Vol. V, 1873, p. 81. KEEP, West Coast Shells, p. 36, 1892.
Columbella tuberosa CPR., TRYON, Man. Conch., Vol. V, p. 135, Pl. L, figs. 40 and 41, 1883.
Columbella (Astyris) tuberosa CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213, Pl. XX, fig. 6.

Shell small, slender; spire elevated; acute apex; whorls seven, only slightly convex; body-whorl angulated, lower portion decidedly concave and ornamented with narrow grooves and ridges; surface of upper whorls smooth except for delicate incremental lines; suture distinct; aperture ovate, and less than one-half the length of shell; anterior end of columella slender; outer lip thickened by row of tubercles on inner side; inner lip smooth; canal short, straight.

Dimensions.—Long. 6.5 mm.; lat. 2.8 mm.; body-whorl 4 mm.; aperture 2.9 mm.; defl. 22 degrees.

Distinguishable from other members of genus by slender spire and angulated body-whorl.

Rare in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at Crawfish George's, Los Cerritos, San Pedro, and Deadman Island. Found also in the Pleistocene at Spanish Bight, San Diego;

and at bath-house, Santa Barbara. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Neah Bay to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Pedro; San Diego; Santa Barbara (Arnold).

Pliocene.—San Diego well (Dall).

Genus **Amphissa** *H. & A. Adams.*

Shell bucciniform, longitudinally ribbed; spire elevated; aperture rather wide, enlarging below, and terminating in a wide anterior sinus; inner lip callous, plicate below; outer lip not thickened on margin, plicate within.

Amphissa corrugata Reeve is a characteristic species.

235. Amphissa corrugata *Reeve.*

Buccinum corrugatum Rve., Icon. Conch., Pl. IV, fig. 110, 1846.

Truncaria corrugata Rve., Cpr., Brit. Assn. Rept., 1863, p. 662.

Cominella (*Amphissa*) *corrugata* Rve., Cpr., Brit. Assn. Rept., 1866. Gabb, Pal. Cal., Vol. II, p. 74, 1869.

Amphissa corrugata Rve., Tryon, Man. Conch., Vol. V, p. 197, Pl. LXIII, fig. 66, 1883. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 228. Keep, West Coast Shells, p. 34, fig. 14, 1892.

Shell small, solid, fusiform; spire elevated; apex acute; whorls seven, slightly convex, with about eighteen to twenty rather wavy, slightly oblique, rounded, transverse ridges extending from suture to suture; spiral ornamentation consists of numerous fine, raised lines in the interspaces between the transverse ridges; suture impressed, distinct; aperture rhomboidal, narrow; outer lip lirate within; inner lip incrusted, smooth; canal short, recurved; pillar spirally lined externally.

Dimensions.—Long. 19 mm.; lat. 9 mm.; body-whorl 13.5 mm.; aperture 10 mm.; defl. 52 degrees.

The Pliocene forms are much smaller than the one described above (a Pleistocene specimen). Carpenter mentions the shells as becoming dwarfed in deep water (40 fathoms).

Rather common in Pliocene and lower San Pedro series at Deadman Island; rare in upper San Pedro series at San Pedro, Los Cerritos, and Crawfish George's. Found also in the Pleistocene at the bath-house, Santa Barbara.

Living.—Alaska to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara (Arnold).

Pliocene.—San Diego well (Dall): San Pedro (Arnold).

236. Amphissa ventricosa, sp. nov.

PLATE V, FIG. 11.

Shell small, broadly fusiform; spire elevated; whorls five or six, evenly convex, with twelve or thirteen strong, rounded, transverse ridges; interspaces sculptured with prominent, regular, equidistant, raised spiral lines, of which there are five or six on the penultimate whorl; suture deeply impressed, distinct; aperture semicircular; outer lip ventricose, thickened with row of teeth; inner lip smooth, incrusted; pillar straight; spirally sculptured on outside; no canal.

Dimensions.—Long. 12 mm.; lat. 6 mm.; body-whorl 8.6 mm.; aperture 6 mm.; defl. 43 degrees.

Resembles *A. bicolor* somewhat, but distinguishable from this species by lack of canal, stronger ribs, and more convex whorls; distinguishable from other members of genus by thin shell, ventricose whorls, semicircular aperture and lack of differentiated canal. Dr. Dall examined the type and pronounced it a new species.

Rare in lower San Pedro series of Deadman Island. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

237. Amphissa versicolor *Dall.*

Amphissa versicolor DALL, Am. Jour. Conch., Vol. VII, 1872, p. 111. TRYON, Man. Conch., Vol. V, p. 197, Pl. LXIII, fig. 67, 1883; Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 213, Pl. XX, fig. 9.

Amphissa corrugata RVE., COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 228 (in part).

Shell small, fusiform; apex acute; whorls seven, convex, slightly angular above; body-whorl slightly ventricose; surface ornamented with about fourteen rounded, obliquely transverse ridges, and several distinct, raised, spiral lines in the interspaces; suture quite deeply impressed; aperture subelliptical; outer lip slightly thickened by lirated ridges on inner side; inner lip incrusted, smooth; columella spirally sculptured externally; canal short, broad, recurved.

Dimensions.—Long. 10.2 mm.; lat. 5 mm.; body-whorl 7 mm.; aperture 5 mm.; defl. 47 degrees.

Distinguishable from *A. corrugata* by more ventricose body-whorl, relatively longer columella and shorter spire, more angulated whorls, deeper suture and less numerous but more oblique and larger transverse ridges. Specimen identified by Dr. Dall.

Found in lower San Pedro series at Deadman Island, and upper San Pedro series at Crawfish George's, Los Cerritos, and Deadman Island. Found also in the Pleistocene at Pacific Beach, San Diego.

Living.—San Pedro (Dall).

Pleistocene.—San Pedro; San Diego (Arnold).

Family LXI. MURICIDÆ.

Genus **Murex** *Linné.*

Shell ovate or oblong; spire prominent; whorls convex, crossed by three or more continuous varices; aperture ending below in a canal, which is generally partly closed.

Murex tenuispena Lam. is a characteristic species.

Subgenus **Chicoreus** *Montfort.*

Shell ovate-pyriform; varices foliated and sometimes spinose; canal short, curved, wide, nearly closed.

Murex adustus Lam. is a characteristic species.

238. **Murex (Chicoreus) leeanus** *Dall.*

PLATE VII, FIG. 1.

Murex (Chicoreus) leeanus DALL, Proc. U. S. Nat. Mus., Vol. XII, 1890, p. 329, Pl. VII, fig. 1.

Shell large, strong, angular in outline; apex sharp; whorls five or six, angular, flat to concave above; each whorl ornamented with three varices, which extend out into long, rather sharp spines; the varices toward the apex fall short of completing a whole whorl, so that they are slightly spirally arranged; a faint node on angle between each pair of varices; surface sculptured with delicate squamose, spiral cinguli, with chiseled grooves between; suture deeply impressed, wavy; aperture elliptical; outer lip smooth; inner lip slightly projecting, smooth; canal long, narrow, slightly curved, covered; older termini of canal visible on pillar at left of canal.

Dimensions.—Long. 55 mm.; lat. 43 mm.; body-whorl 47 mm.; aperture 17 mm.

A large, showy shell, easily distinguishable by the long, sharp varical spines. Specimens identified by Dr. Dall.

Rare in upper San Pedro series at San Pedro and Crawfish George's. The drawing of this species is a composite, and was made from two imperfect specimens from the upper San Pedro series at San Pedro, which are now in the collection of Delos Arnold.

Living.—Cerros Island, off Lower California (Dall).

Pleistocene.—San Pedro (Arnold).

239. **Murex (Chicoreus?) trialatus** *Sowerby.*

Murex trialatus SBY., Proc. Zool. Soc., 1840, p. 143. TRYON, Man. Conch., Vol. II, p. 113, Pl. XXXIV, fig. 372, 1880.

Murex californicus HDS., Proc. Zool. Soc., 1843, p. 128. Voyage Sulphur, Pl. III, figs. 9 and 10, 1844. TRYON, Man. Conch., Vol. II, p. 113, Pl. XXXIV, fig. 375; Pl. XXXV, fig. 287, 1880.

Muricidea californica HDS., CPR., Brit. Assn. Rept., 1863, p. 663. GABB, Pal. Cal., Vol. II, p. 69, 1869.

Shell small, fusiform; spire elevated, subacute; whorls five, convex; body-whorl over three-fourths length of shell; varices three, thick and rounded, elevated on angle of whorl to sharp, prominent nodes; a single, less prominent, rounded node on angle between each pair of varices; spiral sculpture of fine raised lines, with fine incremental lirulæ in the interspaces; aperture ovate; canal long, narrow, slightly recurved, and generally covered by overgrowing sides; lower part of columella slightly widened; outer lip thickened by varix, smooth inner surface; inner lip slightly raised and smoothly enameled.

Dimensions.—Long. 38 mm.; lat. 21.5 mm.; body whorl 30 mm.; aperture 22.5 mm.; canal 11 mm.; defl. 60 degrees.

Rare in upper San Pedro series at San Pedro, Deadman Island, and Crawfish George's.

Living.—Baulinas Bay to San Diego (Carpenter): Lower California (Hemphill).

Pleistocene.—San Pedro (Arnold).

Subgenus **Pteronotus** *Swainson.*

Shell triangular; varices fin-like or foliated; canal moderate, closed, somewhat curved.

Murex trigonulus Lam. is a characteristic species.

240. **Murex (Pteronotus) festivus** *Hinds.*

Murex festivus HDS., Proc. Zool. Soc., 1843, p. 127; Voyage Sulphur, p. 9, Pl. III, figs. 13 and 14, 1844. TRYON, Man. Conch., Vol. II, p. 116, Pl. XXXV, fig. 383, 1880.

Pteronotus festivus HDS., CPR., Brit. Assn. Rept., 1863, p. 663. GABB, Pal. Cal., Vol. II, p. 70. 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 261. DALL, Trans. Wagner Inst. Sci., Vol. III, Part I, 1890, p. 142. KEEP, West Coast Shells, p. 22, fig. 3, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 216.

Shell of moderate size, fusiform; spire elevated, short; whorls six, subangulate, crossed by three prominent, reflexed, frill-like varices; a single rounded node between each set of varices; numerous spiral lines, which are almost obsolete, ornament the intervarical spaces; suture deeply impressed; aperture pyriform; outer and inner lips smooth; canal long, narrow, slightly curved; columella squamose on outside, widened slightly.

Dimensions.—Long. 40 mm.; lat. 21 mm.; body-whorl 31 mm.; aperture, not including canal, 12 mm.; canal 11 mm.; defl. 65 degrees.

This species is characterized by the sharp, frill-like varices said by Dr. Dall to resemble quite closely *P. textilis* Gabb, of the Miocene of San Domingo and Hayti, and the Pliocene of Florida.

Rare in the lower San Pedro series at Deadman Island; not uncommon in the upper San Pedro series at Deadman Island, Crawfish George's, San Pedro and Los Cerritos. Found also in the Pleistocene at Spanish Bight, San Diego.

Living.—San Pedro to San Diego; Lower California (Cooper).

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro; San Diego (Arnold).

Subgenus **Pterorhytis** *Conrad.*

Varices wing-like; aperture usually dentate within the outer lip, with a produced tooth near its base.

Type, *Murex nuttalli* Conrad.

241. Murex (Pterorhytis) foliatus *Martyn.*

Cerostoma foliatum MARTYN, Univ. Conch., No. 66, Pl. XXIV, fig. 1, 1784. CPR., Brit. Assn. Rept., 1863, p. 663. KEEP, Common Sea Shells, Pl. XIV, fig. 5, 1881; West Coast Shells, p. 27, 1892.
Murex foliatus MART., TRYON, Man. Conch., Vol. II, p. 113, Pl. XXXIV, figs. 370, 371, 373, 1880.
Pterorhytis foliatus MART., COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 24.

Shell small, broadly fusiform, with extended varices; spire elevated, subacute; whorls three to four; varices three, widely expanded, foliated on anterior side; one prominent node on convex surface of whorl between each set of varices; aperture subovate, with smooth outer and inner lip; canal long, narrow, expanding anteriorly, generally covered by overgrowing lips.

Dimensions.—Long. 35 mm.; lat. 21 mm.; body-whorl 26.5 mm.; aperture 21 mm.; canal 10 mm.

Distinguishable by the wing-like, foliated varices. The specimen described was too poor to figure.

Rare in the upper San Pedro series of San Pedro; one specimen found.

Living.—Vancouver to Oregon (Carpenter): Sitka to Santa Barbara; Asia (Cooper).

Pleistocene.—San Pedro (Arnold): Puget Sound; San Diego; Santa Barbara Islands (Carpenter): San Joaquin Bay, Orange County (Bowers).

242. Murex (Pterorhytis) nuttalli *Conrad.*

Cerostoma nuttalli CON., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 264, Pl. XX, fig. 22. CPR., Proc. Zool. Soc., 1856, p. 229; Brit. Assn. Rept., 1863, p. 663. TRYON, Struct. and Syst. Conch., Vol. II, p. 105, Pl. XLIII, fig. 8, 1883. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 233. KEEP, West Coast Shells, p. 26, fig. 8, 1892.
Pterorhytis nuttalli CON., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 215.

Shell of medium size, heavy, thick; spire elevated, subacute; whorls four, convex, each with three prominent varices, which are rather smooth behind, but showing their lamellar structure in front; each varix is connected with the analogous varix on the preceding whorl, but the varices being slightly less than one-third of a revolution apart cause the radiating ridges formed by the connected varices to be spirally twisted; intervarical spaces prominently spirally ribbed, the ribs extending on to the backs of the varices; seven or eight prominent spiral ribs on the body-whorls; aperture elliptical; outer lip with eight or nine internal teeth, each corresponding to one of the external sulcations of the body-whorl; sometimes with prominent tooth near anterior portion of outer lip; inner lip smooth; canal rather short, covered; lower portion of columella expanded, rough, subpunctate.

Dimensions.—Long. 65 mm.; lat. 34 mm.; body-whorl 50 mm.; aperture 25 mm.; canal 14 mm.

This species may be only a variety of *P. foliatus* Mart. It is distinguishable from the latter species by the greater prominence of its spiral sculpture, and its lower varices.

Rare in upper San Pedro series at Deadman Island and Los Cerritos.

Living.—Baulinas Bay to San Diego (Cooper).

Pleistocene.—San Pedro (Arnold): San Diego (Cooper).

243. Murex (Pterorhytis) monoceros *Sowerby*.

Murex monoceros SBY., Proc. Zool. Soc., 1840, p. 143. TRYON, Man. Conch , Vol. II, p. 115, Pl. XXXV, figs. 388, 389, 1880.

Muricidea (*Phyllonotus*) *paucivaricata* GABB, Pal. Cal., Vol. II, p. 43, Pl. XIV, fig. 1, 1869 (*fide* TRYON).

Muricidea paucivaricata GABB, COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 252 (*fide* TRYON).

Shell moderate in size, fusiform; spire nearly as long as aperture; whorls seven, subangulated, bearing eight or nine large, longitudinal ribs which develop into prominent nodes on the angle; suture irregular, appressed, distinct; aperture ovate; canal rather short, narrow, recurved, and often overgrown by two lips; outer lip thickened, denticulated with four sharp teeth; inner lip slightly projecting, smooth, incrusted; columella widened; varices two or three, never prominent, sometimes obsolete; numerous small revolving ribs crossed by small squamose plates; body-whorl sometimes ornamented with five or six, quite prominent, rounded, spiral ridges.

Dimensions.—Long. 46 mm.; lat. 23 mm.; body-whorl 32 mm.; aperture, including canal, 26 mm.; canal 9 mm.; defl. 50 degrees.

Distinguishable from *M. californica* by denticulated outer lip, lack of varices, thicker shell, and generally larger size. Originally described from Pleistocene specimen.

Rare in upper San Pedro series of San Pedro.

Living.—Lower California?

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro (Arnold).

Genus Monoceros *Lamarck*.

Shell ovate; last whorl large; spire rather elevated; aperture semilunar; inner lip wide and flattened; outer lip crenated, with a prominent tooth usually at the forepart.

Monoceros lugubre Sowb. is a characteristic species.

244. Monoceros engonatum *Conrad*.

Monoceros engonatum CON., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 264, Pl. XX, fig. 17. CPR., Brit. Assn. Rept., 1863, p. 663. GABB, Pal. Cal , Vol. II, p. 75, 1869. TRYON, Man. Conch., Vol. II, p. 195, Pl. LXI, figs. 304, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 251. KEEP, West Coast Shells, p. 29, fig. 10, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 214.

Monoceros unicarinatum RVE., Icon. Conch., Sp. 1.

Shell of medium size, fusiform; whorls six, angular, flattened to concave above and below; spirally sulcate, sulci with tranverse lamellar striæ; suture deeply appressed, distinct; aperture subelliptical; outer lip effuse, dentate within; inner lip slightly flattened, smooth; canal deep, narrow, recurved; pillar twisted, squamose.

Dimensions.—Long. 40 mm.; lat. 20 mm.; body-whorl, 30.5 mm.; aperture 24 mm.; defl. 55 degrees.

This is a variable species. Specimens showing the scaly surface of var. *spiratum* grade over into the smooth form; the sharp-keeled forms merge into those which approach very near to *M. lapilloides*. Some specimens have thin and smooth outer lips, while others are strongly dentate. Of fifty specimens from the San Pedro Pleistocene only three have the characteristic tooth developed, thus showing that in these earlier forms this distinguishing characteristic was only occasional. The scaly specimens are generally the strongest keeled. This latter form is the var. *spiratum* of Blainville.

Found in all of the lower and upper San Pedro series localities in the vicinity of San Pedro. Found also in the Pleistocene at Barlow's ranch, Ventura; and at Pacific Beach, San Diego.

Living.—Baulinas Bay to San Diego (Cooper).

Pleistocene.—San Pedro; San Diego (Cooper): Lake Merced, San Mateo County; San Pedro; San Diego; Ventura (Arnold).

245. **Monoceros lapilloides** *Conrad.*

Purpura (*Monoceros*) *lapilloides* Con., Jour. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 265, Pl. XX, fig. 18.

Monoceros lapilloides Con., = *M. punctatum* Gray, + *M. brevidens* Con. (*fide* Cpr., Brit. Assn. Rept., 1863, p. 663). Keep, West Coast Shells, p. 28, fig. 9, 1892. Cooper, Bull. No. 4, Cal. St. Min. Bureau, 1894, Part 3, p. 28.

Shell of medium size, purpuroid-shaped; spire elevated; apex subacute; whorls four, very slightly convex; surface ornamented with nearly obsolete spiral cinguli and nearly obsolete, irregular, wavy, transverse ridges; suture impressed, indistinct; aperture subovate; outer lip thickened, dentate; inner lip flattened, smooth; canal short.

Dimensions.—Long. 20.5 mm.; lat. 13 mm.; body-whorl 18 mm.; aperture 14 mm.; defl. 67 degrees.

The specimen described shows the reddish color of the live shells. Distinguishable from *M. engonatum* by much shorter spire, broader and shorter pillar, and much less angular whorls; distinguishable from *Purpura saxicola* by relatively larger spire, narrower aperture, dentate outer lip and spiral cinguli.

Rare in upper San Pedro series of San Pedro; one specimen.

Living.—Santa Barbara to San Diego (Carpenter): Monterey (Cooper).

Pleistocene.—San Pedro (Arnold): Ventura County (Bowers).

Genus **Chorus** *Gray.*

Shell laminately varicose; spinose on the shoulder; canal rather long; outer lip with a spine as in *Monoceros.*

Type, *Chorus belcheri* Hinds.

246. **Chorus belcheri** *Hinds.*

Murex belcheri Hds., Proc. Zool. Soc., 1843, p. 127; Voyage Sulphur, Pl. II, figs. 1-3, 1844. Pfeiffer, Nov. Conch., Ser. II, p. 35, Pl. X, figs. 6, 7.

Chorus belcheri Hds., Cpr., Brit. Assn. Rept., 1863, p. 663. Tryon, Man. Conch., Vol. II, p. 198, Pl. LXI, fig. 309, 1880; Syst. Conch., Vol. II, p. 114, Pl. XLV, figs. 43, 44, 1883. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 235. Keep, West Coast Shells, p. 25, fig. 7, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 216.

Shell large, broadly fusiform; spire slightly elevated; whorls five, sharply angulated, with eight or nine nearly obsolete varices which rise to prominent blunt nodes or spines on the angle of whorl; incremental lines prominent; spiral liration on upper whorls; suture impressed, distinct; aperture ovate; outer lip not thickened, effuse; inner lip incrusted; columella widened; umbilicus perforate; canal long, narrow, curved backwards.

Dimensions.—Long. 90 mm.; lat. 62 mm.; body-whorl 78 mm.; aperture 40 mm.; canal 25 mm.; defl. 95 degrees.

A beautiful shell, one of the largest gastropods found in this formation.

Rare in upper San Pedro series at Crawfish George's, Los Cerritos, and San Pedro. Found also in the Pleistocene at Barlow's ranch, Ventura.

Living.—Catalina Island to San Diego; Lower California (Cooper): Sitka (Carpenter): Japan (Tryon).

Pleistocene.—San Pedro (Cooper; Arnold): Ventura (Arnold).

Pliocene.—San Diego well (Dall).

Genus **Eupleura** *H. & A. Adams.*

Shell ranelliform, with a pair of lateral varices, one on either side, and intermediate smaller varices; aperture dentate within.

Eupleura caudata Say is a characteristic species.

247. **Eupleura muriciformis** *Broderip.*

PLATE IX, FIG. 16.

Ranella muriciformis BROD., Proc. Zool. Soc., 1832, p. 179. RVE., Conch. Icon., *Ranella*, Pl. VII, fig. 34, 1844.

Ranella plicata RVE., Proc. Zool. Soc., 1844, p. 138; Conch. Icon., *Ranella*, Pl. VII, fig. 33, 1844.

Ranella triquetra RVE., Proc. Zool. Soc., 1844, p. 139; Conch. Icon., *Ranella*, Pl. VII, fig. 41, 1844. CPR., Brit. Assn. Rept., 1863, p. 667; 1856, p. 201. GABB, Pal., Vol. II, p. 73, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 262.

Eupleura muriciformis BROD., CPR., Brit. Assn. Rept., 1856, p. 182. TRYON, Man. Conch., Vol. II, p. 168, Pl. XXXIX, figs. 501, 502, 504, 505, 1880. DALL, Trans. Wagner Inst. Sci., Vol. III, Part I, 1890, p. 145.

Eupleura muriciformis (var.?) *unispinosa* DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 174, Pl. VI, fig. 5.

Shell of medium size, quite broadly fusiform, solid; spire elevated; whorls five, subangular at lower one-third, concave to straight above, convex below; whorls crossed by varices at every two-thirds revolution, the two varices on the body-whorl and the next varix posterior to these are prominent, the others being obsolete in most cases; the varices are generally thin, webbed, and with six obsolete spines; the spine at the shoulder is the most prominent, but the second spine, counting forward, is the one corresponding to the axis of the intervarical nodes; the web between the shoulder spine and the suture is bent forward; spiral ridges correspond to each spine; four nodes on angle of whorl between each pair of varices; suture deeply impressed, distinct; aperture elliptical; outer lip thickened by six dentiform calluses, one each between each pair of external spiral ridges; canal long, narrow, nearly straight.

Dimensions.—Long. 25.5 mm.; lat. 14 mm.; body-whorl 20.5 mm.; aperture, including canal, 17.5 mm.; canal 7 mm.; defl. 70 degrees.

The prevailing type of the San Pedro fossil specimens does not correspond exactly to any of the descriptions of the living varieties of this species as given by Dr. Dall in the paper cited above. It comes nearest to var. *unispinosa*, differing from that form by having a straight canal. The name var. *pleistocenensis* is suggested for the San Pedro fossil form.

Rare in the upper San Pedro series of San Pedro; one specimen from lower San Pedro series at Deadman Island. Found also in the Pleistocene at Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—California to Venezuela (Dall).

Pleistocene.—San Pedro (Arnold): San Diego (Dall; Cooper; Arnold): Pacific coast of Lower California; head of the Gulf of California (Dall).

248. **Eupleura muriciformis** var. **curta**, var. nov.

PLATE VIII, FIG. 9.

Shell small, broadly fusiform; whorls four, angular, flat above, convex below; two sharp spiral ridges on upper whorls, six on body-whorl corresponding to obsolete spines on varix; one prominent varix on body-whorl, other varices obsolete; whorls crossed by prominent, narrow, rounded ridges, of which there are twelve on the penultimate whorl; aperture elliptical; outer lip thickened by a row of six denticles; inner lip smooth, projecting; canal short, narrow.

Dimensions.—Long. 15 mm.; lat. 10 mm.; body-whorl 11 mm.; aperture, including canal, 9.5 mm.; canal 2.2 mm.; defl. 65 degrees.

Differs from *E. muriciformis* in having obsolete varices, transverse ridges instead of nodes, much shorter canal, and in general much stronger sculpture.

The type, which is figured, is from the upper San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Genus **Trophon** *Montfort.*

Varices numerous, lamelliform or laciniated; spire prominent; aperture ovate; canal open, usually turned to the left; shell white, often dark colored within the aperture.

Trophon clathratus Linn. is a characteristic species.

Subgenus **Boreotrophon** *Fischer.*

249. **Trophon (Boreotrophon) cerritensis**, sp. nov.

PLATE VI, FIG. 6.

Shell of medium size, elongate-fusiform, heavy; whorls six, angular, with angle in middle, crossed by about eighteen strong, transverse ribs; lower portion of whorls ornamented with two or three strong, spiral ridges, one of which is on the angle, the two systems of ridges giving a cancellated surface; body-whorl and columella cancellated; suture deeply impressed, distinct; aperture elliptical; outer lip thickened, smooth within; inner lip incrusted, smooth; columella only faintly squamose, curved and slightly twisted; canal rather short, narrow.

Dimensions.—Long. 33 mm.; lat. 15 mm.; body-whorl 23 mm.; aperture, including canal, 18 mm; canal 7 mm.; defl. 44 degrees.

The largest of the *Trophons* so far found in this locality. The adult of this shell resembles var. *præcursor*, but is distinguishable from that species by its larger size, heavier shell, more prominent spiral ridges, proportionally shorter canal, and in having the angle near the middle of the whorl, rather than posterior to the middle; distinguishable from *T. stuarti* by heavier shell, more numerous and much heavier, lower and more rounded, transverse ridges, shorter canal, and by having the angle in the middle of the whorl. The young of *T. cerritensis* resembles *T. pedroana* somewhat, but may be distinguished from that species by its heavier shell, more depressed outline and much shorter canal. An adult found at Los Cerritos has fewer transverse ridges and a higher angle than the type. Type from lower San Pedro series of Deadman Island. Said by Dr. Dall to be near *T. craticulatus* Fabricius.

One adult specimen (type) and five juniors found in lower San Pedro series at Deadman Island; one specimen from Los Cerritos in upper San Pedro series. The specimen figured is the type, which is from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

250. Trophon (Boreotrophon) gracilis *Perry.*

PLATE VI, FIG. 8.

Polyplex gracilis PERRY, Conch., Pl. IX, fig. 4.
Trophon multicostatus (not of ESCH.) GABB, Pal. Cal., Vol. II, p. 70, 1869 (in part). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268 (in part).

Shell of medium size, fusiform; spire elevated; whorls five or six, sharply angular, crossed by eight or nine frill-like varices, which flex forward and are only slightly coronate on angle; surface smooth; suture deeply impressed, giving tabulate appearance to upper part of whorl; aperture elliptical; outer lip effuse, smooth within; inner lip smooth; columella long, slightly twisted; canal long, narrow, recurved.

Dimensions.—Long. 26 mm.; lat. 13 mm.; body-whorl 19.5 mm; aperture 16.2 mm.; canal 7.7 mm.; defl. 62 degrees.

Distinguishable by frill-like varices and lack of spiral sculpture. Specimens identified by Dr. Dall. This species is the *T. multicostatus* of most western collectors. It differs from that species in having fewer, but more prominent varices, and in being a broader shell.

Rare in Pliocene and lower San Pedro series of Deadman Island. Found also in the Pleistocene at bath-house, Santa Barbara. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living. Circumpolar; Sitka to Monterey (Cooper).

Pleistocene.—Santa Barbara (Cooper; Arnold): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

251. Trophon (Boreotrophon) multicostatus *Eschscholtz*.

PLATE VI, FIG. 9.

Murex multicostatus ESCH., Zool. Atlas, Vol. II, p. 11, Pl. IX, fig. 4, 1829. KUSTER, *Murex*, p. 45, Pl. XVIII, figs. 5 and 6, 1837.

Trophon multicostatus ESCH., H. & A. ADAMS, Gen. Rec. Moll., Vol. 1, p. 77. CPR., Brit. Assn. Rept., 1863, p. 663 (in part). TRYON, Man. Conch., Vol. II, p. 141, Pl. XXXI, fig. 316, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p 269 (in part). KEEP, West Coast Shells, p. 21, 1892 (in part).

Shell small, fusiform; whorls five, angular above, with twelve to fourteen raised varices; no spiral sculpture; aperture subelliptical; outer lip not effuse; inner lip smooth; canal short, slightly curved.

Dimensions.—Long. 10.5 mm.; lat. 4.5 mm.; body-whorl 7 mm.; aperture, including canal, 5 mm.; canal 1 mm.; defl. 40 degrees.

The shell described is a small one. Distinguishable from *T. gracilis* by having larger number of varices, less prominent varices, more slender shell, a less effuse outer lip, and less sharply angulated whorls. Identified as "*T. multicostatus* var.?" by Dr. Dall.

Rare in the lower San Pedro series at Deadman Island, and in upper San Pedro series at San Pedro. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Sitka to Monterey; circumpolar (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

252. Trophon (Boreotrophon) pedroana, sp. nov.

PLATE VI, FIG. 12.

Shell small, elongate-fusiform, thin; spire elevated, acute; whorls six, convex, with very slight angle about one-third width from posterior margin; body-whorl slightly ventricose; whorls ornamented with about fourteen slightly raised, rounded transverse ridges, and two faint spiral ridges, one of which is on the angle of whorl; suture deeply impressed, distinct; aperture semiovate; outer lip thin, not effuse; inner lip smooth; columella long and slender, smooth; canal long, narrow, nearly straight.

Dimensions.—Long. 12 mm.; lat. 4.8 mm.; body-whorl 9 mm.; aperture, including canal, 7 mm.; canal 3 mm.; defl. 35 degrees.

The thinnest, most delicate of the *Trophons* of this locality. Distinguishable from var. *precursor* by thinness, less angulation of whorls, less prominence of sculpture, and simple outer lip; distinguishable from *T. scalariformis* by its thinness, narrowness, and spiral lines; distinguishable from *T. disparilis* Dall by smaller size, more numerous whorls, and more prominent transverse sculpture.

Pronounced a new species by Dr. Dall, who also says that it is near *T. disparilis*, which has been dredged at Gray's Harbor, Alaska.

Rather common in the lower San Pedro series at San Pedro and Deadman Island; found also in upper San Pedro series at Crawfish George's. The specimen figured is the type, which came from the lower San Pedro series at Deadman Island, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

253. Trophon (Boreotrophon) scalariformis *Gould.*

PLATE VI, FIG. 10.

Fusus scalariformis GLD., Invert. Mass., p. 288, fig. 208.
Trophon scalariformis GLD., TRYON, Man. Conch., Vol. II, p. 141, Pl. XXXI, fig. 314, 1880.

Shell small, fusiform, spire elevated, subacute; whorls four or five, convex, crossed by about thirteen prominent rounded ribs, most prominent in middle of whorl; body-whorl ventricose; suture impressed, distinct; aperture broadly ovate; outer lip slightly effuse; inner lip curved, smooth; columella long, rather narrow, curved, smooth; canal of medium length, narrow.

Dimensions.—Long. 16 mm.; lat. 7.5 mm.; body-whorl 10.5 mm.; aperture, including canal, 8 mm.; canal 3 mm.; defl. 44 degrees.

Somewhat resembles *T. multicostatus*, but is distinguishable by lack of angulation in whorls, longer columella and canal, but rather more ventricose body-whorl; easily distinguishable from *T. pedroana* by more depressed aspect of shell and lack of spiral lines. Very faint spiral lines sometimes visible. Specimens identified by Dr. Dall.

Rather common in lower San Pedro series, rare in Pliocene of Deadman Island; found in the lower San Pedro series at San Pedro; and in the upper San Pedro series at Crawfish George's. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Circumboreal. Gulf of St. Lawrence.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

254. Trophon (Boreotrophon) stuarti *Smith.*

PLATE VI, FIG. 4.

Trophon stuarti SMITH, Proc. Zool. Soc., 1880, p. 481, Pl. XLVIII, fig. 6.
Trophon orpheus GLD., CPR., Brit. Assn Rept., 1863, p. 663 (in part). TRYON, Man. Conch., Vol. II, p. 139, Pl. XXXI, fig. 310, 1880 (in part). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268 (in part). KEEP, West Coast Shells, p. 21, 1892 (in part).

Shell of medium size, fusiform; spire elevated, acute; whorls seven, sharply angular, crossed by nine to eleven frill-like varices which rise to sharp points on angle; whorls ornamented with two to three sharp, spiral ridges, one of which revolves on angle; aperture semielliptical; outer lip thickened, smooth within; inner lip incrusted, projecting; columella long, twisted, squamose; canal long, narrow, slightly curved.

Dimensions.—Long. 30 mm.; lat. 13 mm.; body-whorl 2 mm.; aperture, including canal 16.5 mm.; canal 8 mm.; defl. 52 degrees.

Distinguishable by prominent, frill-like varices and sharp spiral lines, which give latticed appearance. Specimens identified by Dr. Dall.

Rare in Pliocene of Deadman Island and Timm's Point; also reported from lower San Pedro series at Deadman Island. The specimen figured is from the Pliocene at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Sitka to Straits of Fuca; Washington (Cooper).

Pleistocene.—San Pedro; San Diego (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold): San Diego well (Dall).

255. **Trophon (Boreotrophon) stuarti** *Smith* var. **præcursor**, var. nov.

PLATE VI, FIG. 5.

Shell small, elongate-fusiform; spire elevated, acute; whorls six or seven, angulated above, crossed by about fifteen sharp varices, and with two sharp spiral lines; suture deeply impressed, distinct; aperture subelliptical; outer lip effuse, smooth; inner lip smooth; columella long, straight, nearly smooth; canal long, narrow, very slightly curved.

Dimensions.—Long. 15 mm.; lat. 5.5 mm.; body-whorl 10 mm.; aperture, including canal, 8 mm.; canal 4.2 mm.; defl. 35 degrees.

Distinguishable from *T. stuarti* by smaller size, less prominent transverse frills and spiral lines, and slenderer form; distinguishable from *T. disparilis* by much more sharply defined sculpture and more angulated whorls. Pronounced var. *præcursor* of *T. stuarti* by Dr. Dall. Type from Pliocene of Deadman Island.

Not uncommon in Pliocene and lower San Pedro series of Deadman Island. Found also in Pleistocene at bath-house, Santa Barbara. The specimen figured is the type, which was found in the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Pedro; Santa Barbara (Arnold).

256. **Trophon (Boreotrophon) tenuisculptus** *Carpenter*.

Trophon tenuisculptus CPR., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XVII, 1866, p. 277. GABB, Pal. Cal., Vol II, p. 70, 1869. TRYON, Man. Conch., Vol. II, p. 139, Pl. XXXIII, fig. 359, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268.

Shell small, fusiform; whorls five, angulated above, forming a slightly sloping, tabular band above; ornamentations of numerous transverse ridges and several spiral lines; suture deeply impressed; aperture elliptical; outer lip thin; inner lip incrusted, smooth; canal narrow; columella long, twisted.

Dimensions of a Young Specimen.—Long. 14.5 mm.; lat. 6.1 mm.; body-whorl 10 mm.; aperture and canal 8 mm.; canal 4.5 mm.; defl. 50 degrees.

Distinguishable by numerous transverse ridges, which are more numerous than in any other member of this genus found in this locality. Type of species from Pleistocene of Santa Barbara. Specimen identified by Dr. Dall.

Rare in Pliocene of San Pedro district.

Pleistocene.—Santa Barbara (Carpenter).

Pliocene.—San Pedro (Arnold).

257. Trophon (Boreotrophon) triangulatus *Carpenter*.

Trophon triangulatus CPR., Brit. Assn. Rept., 1863, p. 663; Proc. Cal. Acad. Sci., Vol. III, 1865, p. 224. TRYON, Man. Conch., Vol II, p 42, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268.

Trophon (Boreotrophon) triangulatus CPR., DALL, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 180, Pl. V, figs. 1, 3 and 6; Vol. XV, 1892, p. 216.

"Whorls about seven, the nuclear lost; varices six to the whorl, strong, wide, thin-edged, with guttered spines which have their hinder edge rounded; surface with strongly marked lines of growth and half obsolete, fine, irregular, spiral scratches, strongest on the body and almost wholly wanting between the suture and the spines; the aperture in some specimens might be denticulate.

"*Dimensions.*—Long. 75 mm.; lat. 50 mm.; aperture 56 mm."

As the only shell found in the Pleistocene was an extremely young and worn specimen, the above, taken from a description by Dr. Dall (Proc. U. S. Nat. Mus., Vol. XIV, p. 180), is inserted. The Pleistocene specimen measures 9 mm. in length, and has nine varices. The young of this species is distinguishable from the young of *T. gracilis* by having a shorter canal and less prominent varices.

Rare in lower San Pedro series of Deadman Island.

Living.—Santa Cruz Island to Catalina; Lower California (Cooper): San Pedro (Williamson).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Genus **Ocinebra** *Leach*.

Shell small, with numerous varices which are foliated and often spinose; spiral sculpture; canal more or less closed.

Ocinebra erinaceus Linn. is a characteristic species.

258. Ocinebra barbarensis *Gabb*.

PLATE V, FIG. 1.

Murex barbarensis GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 183.

Muricidea barbarensis GABB, Pal. Cal., Vol. II, p. 69. 1869.

Ocinebra barbarensis GABB, TRYON, Man. Conch., Vol. II, p. 124, 1880.

Shell small, fusiform; spire elevated, subacute; whorls four or five, sharply angulated, flat or concave above, slightly convex below, ornamented with five to nine rather sharp, transverse ridges, which rise to a sharp, recurved process on angle, and by numerous strong, squamose, revolving ridges; suture very deeply appressed, giving spire a staircase appearance; aperture subelliptical; outer lip thickened, denticulated; inner lip incrusted, projecting slightly; canal short, narrow, generally covered; columella slightly widened and twisted.

Dimensions.—Long. 19 mm.; lat. 10 mm.; body-whorl 15 mm.; aperture, including canal, 11 mm.; canal 5 mm.; defl. 60 degrees.

Distinguishable from *O. perita* by more prominent processes on angle of whorl, more prominent spiral ridges, deeper appressed suture, and more tabulated upper portion of whorl. Specimens identified by Dr. Dall.

Rare in the lower San Pedro series at San Pedro and Deadman Island. Found also in the Pleistocene at Santa Barbara. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Catalina Island; Santa Barbara Channel (Cooper).

Pleistocene. Santa Barbara (Gabb; Arnold): San Pedro (Arnold).

259. Ocinebra foveolata *Hinds.*

Murex foveolata Hds., Proc. Zool. Soc., 1843, p. 127: Voyage Sulphur, p. 9. No. 13, Pl. III, figs. 15, 16, 1844. Cpr., Brit. Assn. Rept., 1856, p. 205. Tryon, Man. Conch., Vol. II, p. 125, Pl. XXXVIII fig. 465, 1880.

Muricidea foveolata Hds., Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 252.

Ocinebra foveolata Hds., Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892. p. 215.

Shell of medium size, fusiform; spire elevated; whorls six, angulated, with six or seven prominent, rounded, transverse ribs that rise to the prominence of nodes on the angle of the whorl; surface ornamented with numerous clear-cut, rather squarish, raised lines, and incremental lirulæ in the interspaces; suture deeply appressed, wavy; aperture subpyriform; outer lip thickened, denticulated; inner lip incrusted, smooth; canal long, narrow, slightly curved; columella not perceptibly widened; umbilicus subperforate.

Dimensions.—Long. 35 mm.; lat. 17 mm.; body-whorl 28 mm.; aperture, including canal, 20 mm.; canal 9 mm.; defl. 60 degrees.

Distinguishable by the broad, prominent, transverse ridges which rise to rounded nodes rather than to sharp points, as in some other members of the genus, and by the deep suture and rather long, narrow form of the shell. Specimen identified by Dr. Dall. Specimens of *O. perita* in the State Museum collection of fossils at Berkeley are labeled "*O. foveolata.*"

Rare in upper San Pedro series of San Pedro; one imperfect specimen found.

Living.—Baulinas Bay to Lower California (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold).

260. Ocinebra interfossa *Carpenter.*

Ocinebra interfossa Cpr., Brit. Assn. Rept, 1863, p. 663. Gabb, Pal. Cal., Vol. II, p. 70, 1869. Tryon, Man. Conch., Vol. II, p. 131, Pl. XXXIX, fig. 484, 1880. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 254 Keep, West Coast Shells, p. 24, fig. 5, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 215.

Shell small, broadly fusiform; spire elevated, subacute; whorls five or six, angulated above; surface sculptured with numerous transverse and spiral ridges of nearly equal prominence, giving the surface a latticed appearance; suture deeply impressed, distinct; aperture subovate; outer lip thickened, slightly denticulated; inner lip smooth, incrusted; canal short, generally covered; columella twisted, squamose; umbilicus subperforate.

Dimensions.—Long. 13 mm.; lat. 7.2 mm.; body-whorl 10 mm.; aperture, including canal, 7 5 mm.; canal 2.5 mm.; defl. 55 degrees.

Distinguishable from other members of genus by strong, latticed sculpture, short canal and small size. Identified by Dr. Dall.

Rather common in upper San Pedro series at San Pedro; one in Pliocene at Deadman Island; found also in Lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at Crawfish George's and Deadman Island. Found also in the Pleistocene at Pacific Beach, San Diego.

Living.—Sitka to San Diego (Cooper).

Pleistocene.– Santa Barbara (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Pedro (Arnold).

261. **Ocinebra keepi**, sp. nov.

PLATE V, FIG. 9.

Shell of medium size, fusiform; spire elevated, subacute; whorls five to six, strongly angulated above, giving a tabulate appearance to upper portion; whorls crossed by about seven sharp frills, which flex forward, and rise to prominent points on the angle; anterior portion of whorl ornamented with five or six strong, rough, subangular spiral lines, more prominent on lower portion of whorl; posterior portion of whorl smooth between frills, except near suture, where the surface is roughened by laminated, incremental lines; suture deeply appressed, undulating, distinct; aperture subelliptical; outer lip thickened and slightly denticulated; inner lip enameled, slightly projecting; columella twisted, squamose, only slightly widened; umbilicus subperforate; canal of medium length, narrow, sometimes covered with overgrowing lips.

Dimensions.—Long. 35.5 mm.; alt. 21 mm.; body-whorl 26.5 mm.; aperture 20 mm.; canal 7.5 mm.; defl. 56 degrees.

Distinguishable from other members of the genus by the transverse frills. The type specimen shows the original reddish brown color. Pronounced a new species by Dr. Dall. Named in honor of Professor Josiah Keep of Mills College, who has done so much toward advancing the study of conchology on the Pacific Coast.

Rare in upper San Pedro series at San Pedro; type specimen found at Deadman Island in the upper San Pedro conglomerate. The specimen figured is the type, which is now in the United States National Museum. One specimen from the upper San Pedro series at the lumber yard, San Pedro.

Pleistocene.—San Pedro (Arnold).

262. **Ocinebra lurida** *Middendorf.*

Tritonium luridum MIDD., Mal. Ross., Pl. II., p. 150, Pl. IV., figs. 4, 5, 1849.

Ocinebra lurida MIDD., Cpr., Brit. Assn. Rept., 1863, p. 663. GABB, Pal. Cal., Vol. II., p. 70, 1869. TRYON, Man. Conch., Vol II, p. 131, Pl. XXXIX, figs. 481, 485, 1888. KEEP, West Coast Shells, p. 23, fig. 4, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 215, Pl. XX, fig. 3.

Shell of medium size, fusiform; whorls six, convex, slightly angulated near posterior margin; upper whorls with several transverse ridges; surface ornamented with numerous rounded, raised lines; suture deeply impressed, distinct; body-whorl not extraordinaril yventricose; aperture subovate; outer lip thickened, denticulated; inner lip incrusted; columella widened; umbilicus subperforate; canal narrow, sometimes covered with overgrowing lips.

Dimensions.—Long. 25 mm.; lat. 13.3 mm.; defl. 55 degrees.

Distinguishable by lack of transverse ridges of any kind on body-whorl and its antecedent whorl. Specimen identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; one deformed specimen from Crawfish George's. Found in Pleistocene at Pacific Beach, San Diego.

Living.—Sitka to Santa Barbara (Cooper): San Pedro (U. S. Nat. Mus.).

Pleistocene.—San Pedro; San Diego (Arnold).

263. **Ocinebra lurida** *Midd.*, var. **aspera** *Baird.*

PLATE V, FIG. 12.

Vitularia aspera BAIRD, Proc. Zool. Soc., 1863, p. 66.

Ocinebra lurida var. *aspera* BAIRD, CPR., Brit. Assn. Rept., 1863, p. 663. TRYON, Man. Conch., Vol. II, p. 131, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 254.

Shell of medium size, fusiform; whorls six, convex, with about nine prominent, rounded transverse ribs; surface ornamented with numerous rounded, raised, spiral lines and fine incremental liruke in the interspaces; suture deeply impressed, distinct; body-whorl prominently ventricose, and with transverse, rounded ridges which become obsolete on columella; aperture subovate; outer lip thickened, denticulated; inner lip slightly flattened, incrusted; columella only slightly widened; umbilicus subperforate; canal straight, narrow.

Dimensions.—Long. 27 mm.; lat. 14 mm.; body-whorl 20 mm.; aperture, including canal, 16 mm., canal 6 mm.; defl. 55 degrees.

Distinguishable from *O. lurida* by more ventricose body-whorl, and by the rounded ridges on the lower whorls, which are lacking in *lurida*. Specimens identified by Dr. Dall.

Rather common in the upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's and Deadman Island; also found in the lower San Pedro series at Deadman Island and San Pedro. Found in the Pleistocene at bath-house, Santa Barbara; and irrigating ditch, Ventura. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Sitka to Santa Barbara (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold).

264. **Ocinebra lurida** *Midd.*, var. **cancellina** *Philippi.*

PLATE IX, FIG. 11.

Fusus cancellinus PHIL., Archiv. für Naturg, Bd. I, 1845, p. 67; Abbild., II, *Fusus*, Pl. III, fig. 2.

Urosalpinx cancellinus PHIL., TRYON, Man. Conch., Vol. II, p. 154, Pl. XXXIX, fig. 492, 1880.

Shell small, broadly fusiform; spire elevated, subacute; whorls four, convex; body-whorl ventricose; whorls crossed by about nine prominent, broad, rounded ribs, the interspaces ornamented with prominent rounded, raised spiral lines, between which are numerous squamose incremental liruke; suture not deeply impressed, rather indistinct, undulating; aperture subelliptical; outer lip slightly twisted, squamose, not widened; canal short, rather broad, uncovered; umbilicus subperforate.

Dimensions.—Long. 22 mm.; lat. 12.5 mm.; aperture 12.5 mm.; canal 4 mm.; defl. 62 degrees.

Distinguishable by broad and depressed form, broad, rounded ridges, and prominence of the spiral lines and incremental lirulæ. Specimen identified by Dr. Dall.

Rare in upper San Pedro series at San Pedro. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the United States National Museum.

Living.—Straits of Magellan (Tryon).

Pleistocene.—San Pedro (Arnold).

265. **Ocinebra lurida** *Midd.*, var. **cerritensis**, var. nov.

PLATE V, FIG. 5.

Shell small, broadly fusiform, heavy; spire elevated, subacute; whorls four, convex, enlarging rapidly from the first whorl; body-whorl ventricose; whorls crossed by about nine prominent, rather narrow, rounded ribs, which extend to end of columella; interspaces ornamented with strong, raised, spiral lines; suture impressed, not very distinct; aperture subelliptical; outer lip thickened, with a row of about six prominent denticles; inner lip smooth, incrusted; columella not much widened, abruptly truncated at end; umbilicus subperforate; canal short, straight, narrow.

Dimensions.—Long. 17 mm.; lat. 10 mm.; body-whorl 14.5 mm.; aperture 11 mm.; canal 3 mm.; defl. 60 degrees.

Distinguishable from others of its genus by large body-whorl, depressed appearance, small size and heavy shell. Pronounced a new variety by Dr. Dall.

Rare in upper San Pedro series of the San Pedro region; first found at Los Cerritos; type from Crawfish George's; also found in the lower San Pedro series at Deadman Island and San Pedro. The specimen figured is the type, which is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

266. **Ocinebra lurida** *Midd.*, var. **munda** *Carpenter*.

Ocinebra lurida var. *munda* CPR., Brit. Assn. Rept., 1863, p. 663. DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 215, Pl. XX, fig. 3.

Shell small, fusiform, thick, solid; spire elevated, apex acute; whorls five or six, evenly convex; sculpture consists of rather low, rounded, transverse ridges (of which there are about twelve on the penultimate whorl) and equal, equidistant, rounded, raised, spiral lines (of which there are six on the penultimate whorl); suture quite deeply impressed; aperture elliptical; outer lip thickened with row of denticles interiorly; inner lip and columella smooth; canal short, narrow, generally covered.

Dimensions.—Long. 14 mm.; lat. 6.5 mm.; body-whorl 10 mm.; aperture, including canal, 7.5 mm.; canal 2.5 mm.

Distinguishable from others of the genus by its low, rounded, transverse ribs, which are of the same size and prominence from suture to suture, regular spiral lines and slender shape. The sculpture of this species is less prominent than on the other species of this genus.

Several specimens from the lower San Pedro series of Deadman Island.

Living.—Catalina Island (Dall).

Pleistocene.—San Pedro (Arnold).

267. Ocinebra micheli *Ford.*

PLATE V, FIG. 15.

Shell small, elongate-fusiform; spire elevated, acute; whorls five or six, strongly angulated above, crossed by about nine prominent, rather sharp ridges, which are most prominent on angle; anterior portion of whorl with four or five strong, squamose, raised lines, between which are numerous squamose, incremental lirulæ; suture deeply appressed, distinct; aperture subovate; outer lip thickened, smooth interiorly; inner lip incrusted, slightly raised; columella long, twisted, squamose; canal long, narrow, nearly covered.

Dimensions.—Long. 16 mm.; lat. 7 mm.; body-whorl 11 mm.; aperture, including canal, 8.5 mm.; canal 4 mm.; defl. 40 degrees.

Resembles *O. perita* somewhat, but is distinguishable by more slender form, longer columella, and greater number of transverse ridges. Identified by Dr. Dall.

One specimen from the upper San Pedro series at Crawfish George's, which is figured, and is now in the collection of Delos Arnold.

Living.—West Coast North America.

Pleistocene.—San Pedro (Arnold).

268. Ocinebra perita *Hinds.*

Murex peritus HDS., Proc. Zool. Soc., 1843, p. 129; Voyage Sulphur, p. 9, Pl. III, figs. 23, 24, 1844.
Ocinebra perita HDS., TRYON, Man. Conch., Vol. II, p. 124, 1880.
Muricidea perita HDS., COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 252.

Shell of medium size, fusiform; whorls five, sharply angulated, with about six or seven rather sharp, transverse ridges which are most prominent on angle; surface ornamented with numerous raised lines, with squamose, incremental lirulæ in the interspaces; suture deeply appressed, wavy; aperture subovate; outer lip thickened, denticulated; inner lip smooth, incrusted; canal long, straight, narrow, sometimes covered; columella somewhat twisted, slightly widened; umbilicus subperforate.

Dimensions.—Long. 24 mm.; lat. 12.5 mm.; body-whorl 17 mm.; aperture, including canal 14 mm.; canal 6 mm.; defl. 60 degrees.

Distinguishable from *O. barbarensis* by less prominent points on angle of whorl, and by less prominent spiral lines. Identified by Dr. Dall as probably *O. perita.*

Several specimens labeled by Dr. Dall as "*O. interfossa,* leaning toward *O. perita*" had about one more transverse rib to the whorl than does the typical *O. perita,* the ribs were not so prominent on the angle, but the spiral lines were stronger than in the latter species. Comparing a series of both forms they are seen to intergrade, and they do not vary enough to justify making a variety out of the new form.

Found in the lower San Pedro series at Deadman Island; and in the upper San Pedro series at Deadman Island, San Pedro, and Crawfish George's. Found in the Pleistocene at bath-house, Santa Barbara; and Pacific Beach, San Diego.

Living.—Santa Barbara to Lower California (Cooper).

Pleistocene.—Santa Barbara (Cooper; Arnold): San Pedro; San Diego (Arnold).

269. **Ocinebra poulsoni** *Nuttall.*

PLATE V, FIG. 2.

Ocinebra poulsoni NUTT., CPR., Brit. Assn. Rept., 1863, p. 663. NUTTALL, mss., CPR., Jour. de Conch., Vol. XII, 1865, p. 148. TRYON, Man. Conch., Vol. II, p. 130, Pl. XXXVIII, fig. 475, 1880. KEEP, West Coast Shells, p. 23, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 215. COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 30.

Shell of medium size, elongate-fusiform; spire elevated, compact; whorls six, deeply concave above, convex below, with rounded transverse ridges rising to prominent nodes on angle of lower part of whorl; nuclear whorls coarsely cancellated; ridges obsolete on concave portion of whorl; more or less prominent spiral ridges on lower portion of whorl; spiral sculpture faint on concave surface; fine incremental lines quite prominent; suture not deeply appressed, wavy; aperture semielliptical; outer lip denticulated; inner lip effuse, incrusted, smooth; canal short, narrow; columella slightly twisted, widened; umbilicus subperforate.

Dimensions.—Long. 32 mm.; lat. 16.5 mm.; body-whorl 23 mm.; aperture 16 mm.; canal 5 mm.; defl. 42 degrees.

The specimen described is a narrow form, some of the specimens showing a deflection of 55 degrees. Many of the specimens retain the coloration of the brown spiral bands. Specimens identified by Dr. Dall.

Rare in lower San Pedro series at Deadman Island and San Pedro; not uncommon in upper San Pedro series at San Pedro, Los Cerritos, Crawfish George's, and Deadman Island. Found also in the Pleistocene at Twenty-sixth Street, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Barbara to San Diego (Cooper): Lower California (Carpenter).

Pleistocene.—Ventura (Bowers): San Pedro; San Diego (Arnold).

Subfamily *PURPURINÆ.*

Genus **Purpura** *Bruguière.*

Shell oblong-oval, last whorl large; spire generally short; aperture ovate, large, terminating in a very short oblique channel, or notched; columella flattened; outer lip simple.

Purpura persica Linné is a typical species.

270. Purpura crispata *Chemnitz*.

Purpura crispata CHEM., Conch. Cab., XI, Pl. 187, figs. 1802 and 1803, 1795; KUSTER, Conch. Cab., p. 105, Pl. XIX, figs. 3 and 4, 1837. CPR., Brit. Assn. Rept., 1863, p. 662. TRYON, Man. Conch., Vol, II, p. 175, Pl. LXIII, figs. 163–166, 168, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 261. KEEP, West Coast Shells, p. 33, fig. 13, 1892.

Shell fusiform, thick; spire elevated; apex subacute; whorls five to seven, convex or angulated, with one or more prominent spiral ridges on angular part of whorl; suture impressed, distinct; aperture ovate to elliptical; outer lip effuse, generally denticulate; inner lip incrusted, smooth; canal short, curved backwards; umbilicus subperforate.

Dimensions.—Long. 34 mm.; lat. 20 mm.; body-whorl 26 mm.; aperture, including canal, 22.5 mm.; canal 6 mm.; defl. 55 degrees.

The specimen whose dimensions are given was a small one, but the relative proportions in this specimen seemed to be about the average. A very variable species, some being nearly smooth and some almost spinous in their roughness. The smooth forms generally lack the denticulation of the outer lip. The shell texture is very well preserved in most of the Pleistocene specimens, some of them being almost indistinguishable from living shells.

Not common in the upper San Pedro series of San Pedro, Deadman Island, and Crawfish George's. Found in the Pliocene at Pacific Beach and Russ School, San Diego.

Living.—Sitka to Santa Barbara (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—Seven Mile Beach, San Mateo County (Cooper): San Diego (Arnold).

271. Purpura saxicola *Valenciennes*.

Purpura saxicola VAL., Venus, Pl. VIII, fig. 4, 1846. CPR., Brit. Assn. Rept., 1863, p. 662, =*P. lapillus* COOPER (not LINN. sp., LAM.), GABB, Pal. Cal., Vol. II, p. 75, 1869. TRYON, Man. Conch., Vol. II, p. 174, Pl. LIII, figs. 152, 154*a*, 1880. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 262. KEEP, West Coast Shells, p. 31, fig. 11, 1892.

Shell small, semiglobular; spire slightly elevated; apex subacute; whorls four, angulated, tabular on top; body-whorl ventricose; surface ornamented with obsolete spiral ridges and fine incremental lines; suture impressed, distinct; aperture large, elliptical; outer lip smooth, thin, effuse; inner lip and columella flattened, incrusted, sharp; canal short.

Dimensions.—Long. 18 mm.; lat. 13 mm.; aperture, including canal, 16 mm.; canal 13.5 mm.; defl. 85 degrees.

Quite a variable form. All the Pleistocene specimens at hand show the mottled or banded reddish brown coloration. Distinguishable from *P. crispata* by the small spire, large body-whorl, large aperture, and smoothness of the shell.

Rare in upper San Pedro series of San Pedro; three specimens. Found in the Pleistocene at irrigating ditch, Ventura.

Living.—Alaska to San Diego; Lower California (Cooper).

Pleistocene.—Santa Barbara; San Pedro; Ventura (Arnold).

Pliocene.—Santa Rosa; Kirker's Pass; San Fernando (Cooper): Stanford University (Arnold).

Subfamily *CORALLIOPHILINÆ.*

Genus **Coralliophila** *H. & A. Adams.*

Shell broadly fusiform; nuclear whorls smooth; postnuclear whorls with rasp-like surface, and somewhat open umbilicus.

Coralliophila neritoidea is a characteristic species.

272. **Coralliophila nux** *Reeve.*

Murex nux Rve., Conch. Icon., sp. 81.
Coralliophila nux Rve., Tryon, Man. Conch., Vol. II, p. 210, Pl. LXVI, figs. 368, 374, 1880.

Shell purpuroid shaped; whorls angular; surface rough and cancellated by spiral and transverse squamose ridges, the spiral ridges being the most prominent; suture deep. Longitude about 12 millimeters.

This specimen is too imperfect to allow of a good description. Dr. Dall labeled this specimen "*Coralliophila*, probably var. of *nux.*"

One specimen from the upper San Pedro series of San Pedro.

Living.—Mazatlan to Panama; Gallapagos Islands (Tryon).

Pleistocene.—San Pedro (Arnold).

Suborder STREPTODONTA.

Superfamily PTENOGLOSSA.

Family LXII. SCALIDÆ.

Genus **Scala** *Humphrey.*

Shell mostly pure white and lustrous; turreted, many whorled; whorls round, sometimes separated, ornamented with numerous transverse ribs; aperture round; peristome continuous.

Scala pretiosa Linn. is a characteristic species.

273. **Scala bellastriata** *Carpenter.*

PLATE IX, FIG. 17.

Scalaria bellastriata CPR., Brit. Assn. Rept., 1863, p. 660; Proc. Cal. Acad. Sci., Vol. III, 1864, p. 22. GABB, Pal. Cal., Vol. II, p. 78, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 263.

Scala bellastriata CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 209.

Shell conical, with elevated spire; whorls six, rounded, each having fifteen thin varices; suture almost separating whorls; varices spinous at shoulder, a few of the varices thickened; intervarical spaces ornamented with spiral ridges; aperture slightly elliptical, with longer axis vertical.

Dimensions.—Alt. 17.5 mm.; lat. 10 mm.; defl. 42 degrees.

This species is easily distinguishable by its low spire and by its spiral ornamentation. The only other member of this genus found in this locality which has spiral sculpture is *S. hemphilli*, which has a much slenderer spire and a less impressed suture. The figure of this species is of a living shell from San Pedro, which is now in the collection of Delos Arnold.

Rare; only four found in the upper San Pedro series of San Pedro.

Living.—San Pedro to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

274. **Scala crebricostata** *Carpenter.*

Scalaria crebricostata CPR., Brit. Assn. Rept., 1863, p. 660; Proc. Cal. Acad. Sci., Vol. III, 1864, p. 222. GABB, Pal. Cal., Vol. II, p. 78, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 263.

Shell turreted, thin; spire consists of eight convex whorls, each with fourteen to eighteen slightly oblique, sharp, thin, reflexed, transverse varices; varices show a slightly coronate appearance at the shoulder; suture deep and distinct. Deflection 22 degrees.

Some of the specimens have only slightly reflexed varices, and the amount of coronation varies in different individuals.

Distinguishable from *S. indianorum* by thinner shell, thinner and sharper varices, and more impressed suture; distinguishable from *S. tincta* by more numerous, and generally more reflexed varices; distinguishable from *S. hindsii* by more numerous and less coronated varices. Specimens identified as questionable by Dr. Dall.

Rare in the upper San Pedro series at San Pedro and Deadman Island; also in lower San Pedro series at San Pedro. Found in the Pleistocene at Barlow's ranch and irrigating ditch, Ventura; and at Twenty-sixth Street, San Diego.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro; Ventura; San Diego (Arnold).

275. Scala hemphilli *Dall.*

Scala hemphilli DALL, Proc. U. S. Nat. Mus., Vol. I, 1878, p. 16. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 263.

Shell resembling robust *S. tincta;* nine to twelve varices, coronated behind near suture: surface of whorls beneath the varices longitudinally delicately sculptured with alternate grooves and riblets. Deflection 30 degrees.

Distinguishable from *S. bellastriata* by less prominent spiral sculpture and by a less deflection; from other members of the genus found here by its deflection and the spiral sculpture. The specimen described was identified by Dr. Dall.

One immature specimen from the upper San Pedro series of San Pedro.

Pleistocene.—San Diego (Dall): San Pedro (Arnold).

Pliocene.—San Diego well (Dall).

276. Scala hindsii *Carpenter.*

Scalaria hindsii CPR., Proc. Zool. Soc., 1856, p. 165; Brit. Assn. Rept., 1856, p. 336; 1863, p. 660. KEEP, West Coast Shells, p. 49, fig. 31, 1892, = *S. subcoronata* CPR., (*fide* COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 31).

Scala hindsii CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 209.

Shell small, turreted, thin; whorls eight, evenly convex; varices eight to twelve, sharp, thin, sometimes reflexed, very prominently coronated just anterior to suture; suture deep, distinct; aperture subcircular; lip slightly thickened; inner lip slightly incrusted.

Dimensions.—Long. 11.5 mm.; lat. 5.2 mm.; defl. 27 degrees.

Distinguishable from *S. indianorum* by smaller and thinner shell, fewer, thinner, and more coronated varices, and deeper suture; distinguishable from *S. tincta* by smaller shell, and fewer and more coronate varices; distinguishable from *S. crebricostata* by fewer and more coronate varices. Several specimens were identified by Dr. Dall.

Rare in upper San Pedro series at San Pedro, Deadman Island, Crawfish George's, and Los Cerritos; also reported from lower San Pedro series at Deadman Island and San Pedro.

Living.—Santa Barbara (Jewett): San Pedro (Williamson): Panama (Carpenter).

Pleistocene.—San Pedro (Arnold).

277. Scala indianorum *Carpenter.*

PLATE V, FIG 4.

Scala indianorum CPR., Brit. Assn. Rept., 1863, p. 660; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 31. TRYON, Man. Conch., Vol. IX, p. 70, Pl. XIV, fig. 48, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 263. KEEP, West Coast Shells, p. 50, 1892.

Scala indianorum CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 210.

Shell thick, elongated; spire elevated; apex acute; whorls ten, rounded, with twelve to sixteen heavy, reflexed varices; varices striated with fine incremental lines; suture deep; aperture subcircular; inner lip thickened, forming columella.

Dimensions.—Long. 26.5 mm.; lat. 9 mm.; defl. 32 degrees.

Distinguishable from *S. tincta* by heavier shell, thicker and generally more numerous varices, which are reflexed, and by a more solid appearance caused by the less sunken suture; distinguishable from *S. hindsii* by more whorls, thicker shell, more varices, which are thicker, more reflexed and less coronate, and by less prominent sutures; distinguishable from *S. crebricostata* by thicker shell, thicker varices, which are more reflexed, and by a less prominent suture. Several specimens of this species were identified by Dr. Dall.

Two from the Pliocene of Deadman Island; common in the lower and upper San Pedro series of San Pedro and vicinity. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Diego (Dall): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

278. Scala tincta *Carpenter.*

PLATE V, FIG. 3.

Scalaria tincta CPR., Brit. Assn. Rept., 1863, p. 660. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 263.

Scalaria indianorum var. *tincta* CPR., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 31. TRYON, Man. Conch., Vol. IX, p. 70, Pl. XIV, fig. 49, 1887.

Shell thin, elongate; spire elevated; apex acute; whorls nine to ten, rounded, with ten to twelve thin varices, which are generally not reflexed; suture deep; aperture subcircular; inner lip only slightly thickened.

Dimensions.—Long 25 mm.; lat. 10 mm.; defl. 28 degrees.

Distinguishable from *S. indianorum* by more delicate shell, thinner varices, which are not reflexed as a rule, thinner lip and much deeper suture; distinguishable from *S. hindsii* by more numerous varices, which lack the distinct coronation, and by more whorls and less deflection; distinguishable from *S. crebricostata* by fewer and less reflexed varices. Specimens identified by Dr. Dall.

Rather common in upper, and rare in lower San Pedro series of San Pedro and vicinity. Found in the Pleistocene at Barlow's ranch, Ventura; at Pacific Beach and Twenty-sixth Street, San Diego; and in the Pliocene at Pacific Beach and Russ School, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Santa Cruz to San Diego (Cooper).

Pleistocene.—San Diego (Cooper): San Pedro (Cooper; Arnold): Ventura; San Diego (Arnold).

Pliocene.—San Diego (Cooper; Arnold).

Genus **Opalia** *H. & A. Adams.*

Shell turriculated, imperforate; whorls united, the last with a rib at the base.

Opalia coronata Lam. is a characteristic species.

[S. D.] **Opalia anomala** *Stearns.*

Opalia anomala STEARNS, Proc. Phil. Acad. Nat. Sci., 1875, p. 464, Pl. XXVII, fig. 1. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 245.

Shell solid, imperforate, elongated, conical; spire gradually tapering; whorls convex, when perfect probably eleven to fourteen in number, nearly smooth, being marked only by incremental, and, in some specimens, by an outgrowth varix; suture well defined; basal whorl traversed spirally by an inconspicuous rib, varying in prominence, in some specimens barely discernible; the convexity or angularity of the lower part of the basal whorl modified by the presence or absence of the basal rib.

Dimensions.—Long. 53 mm.; lat. 19 mm.; body-whorl 24.5 mm.; aperture 11 mm.

This large, nearly smooth species has so far been reported only from the Pliocene of San Diego, where it is quite common.

Pliocene.—San Diego (Hemphill; Stearns; Arnold).

279. **Opalia borealis** *Gould.*

Scalaria borealis GLD., Wilkes' Exped., Vol. XII, 1852, p. 207. TRYON, Man. Conch., Vol. IX, p. 76, Pl. XVI, fig. 89, 1887.

Opalia borealis GLD., CPR., Brit. Assn. Rept., 1863, p. 660. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. KEEP, West Coast Shells, p. 49, fig. 30, 1892.

Scala (Opalia) borealis CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 210.

Shell small, turreted, thick; apex generally decollated; whorls seven, only slightly convex; varices eight, rounded, thick, prominent, and forming radiating ridges from the apex; suture impressed, distinct; body-whorl squarely angulated at base, with keel on angle; base flat, smooth; aperture subovate; outer lip thin, effuse; inner lip only slightly incrusted.

Dimensions.—Long. 15 mm.; lat, 6 mm.; defl. 22 degrees.

The specimens described were identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro; two specimens.

Living.—Kamtschatka; Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

280. **Opalia crenatoides** *Carpenter*, var. **insculpta** *Carpenter*.

Opalia (? crenatoides) var. *insculpta* CPR., Brit. Assn. Rept., 1863, p. 660; Ann. & Mag. Nat. Hist., 3rd Series, Vol. XVII, 1866, p. 277. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255.

Shell of medium size, elongated, thick, milk-white; spire elevated, with blunt apex; whorls six, convex; first and second post-nuclear whorls more convex than the remaining whorls, angulated, nearly smooth; last four post-nuclear sharply and strongly angulated above, flattened along middle, and quite abruptly contracted at base; whorls ornamented with twelve to fourteen radiating transverse ribs, which are obsolete on the sides of the whorl, faintly developed at the base, and strongly developed on the top of the whorl, where they are appressed against the antecedent whorl, and appear like nodes on the angle of the whorl; a faint sutural riblet is sometimes noticeable on the base of the whorl; above this sutural riblet are faint holes, corresponding to the intercostal spaces; fine incremental striations are visible over the whole surface of the shell; the base of the body-whorl, just below the angle, is ornamented with a prominent, wide, elevated rib; aperture elliptical; outer lip thickened, rounded, slightly expanded at columella; this lip is finely, concentrically striated; inner lip rounded, smooth.

Dimensions.—Long. 16.4 mm.; lat. 8.3 mm.; body-whorl 9.9 mm.

This species is distinguishable by its broad form and sharply angular whorls, which are prominently sculptured above, with obsolete sculpture on the sides of the whorl. Carpenter's type specimen was a post-Pliocene fossil from Santa Barbara.

Rare in the upper San Pedro series at Deadman Island.

Living.—Santa Cruz to Santa Barbara (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

[S. D.] **Opalia varicostata** *Stearns*.

Opalia varicostata STEARNS, Proc. Phil. Acad. Nat. Sci., 1875, p. 463, Pl. XXVII, figs. 2-5. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 245.

Shell elongated-conical, turreted, tapering, solid, imperforate; aperture ovate; peristome continuous, thickened; dingy to clear white; suture well defined; whorls united, exceedingly variable in convexity and altitude; specimens all decollate or truncated, equally solid, though varying in length from 20 to 60 millimeters, showing four and one-half whorls within the first measurement to five in the latter; longitudinal ribs nine to twelve, varying in number, prominence and regularity, as well as in obliquity and thickness; suture more or less waved, dependent upon the prominence of the ribs, which terminate anteriorly at and join a transverse (spiral) rib at about the middle of the basal whorl.

Dimensions of a Rather Small Specimen.—Long. 34 mm.; lat. 14.5 mm.; body-whorl 17 mm.; aperture 9 mm.

This magnificent but variable species has so far been reported only from the Pliocene of San Diego, where it is quite common.

Pliocene.—San Diego (Hemphill; Stearns; Arnold).

Superfamily GYMNOGLOSSA.

Family LXIII. EULIMIDÆ.

Genus **Eulima** *Risso*.

Shell small, white, and polished; slender, elongated with numerous level whorls; spire often curved to one side; obscurely marked on one side by a series of periodic mouths which form prominent ribs internally; apex acute; aperture oval, pointed above; outer lip thickened internally; inner lip reflected over the pillar, not umbilicated.

Eulima tortuosa Adams is a characteristic species.

281. **Eulima falcata** *Carpenter*.

PLATE IX, FIG. 15.

Eulima falcata CPR., Proc. Zool. Soc., 1865, p. 280.

Shell small, elongated, thin, white, glossy; spire very acute, curved into scythe-shape; whorls ten, flat; suture indistinct, not impressed; body-whorl subangular at base; base elongated; aperture pyriform, seemingly appressed to side of shell out of its normal position; outer lip acute and rounding; inner lip concave.

Dimensions.—Long. 6.5 mm.; lat. 3 mm.; body-whorl 3 mm.; aperture 2.5 mm.; defl. 30 degrees.

Distinguishable from *E. micans* by subangulated body-whorl, eccentric aperture and curved spire; distinguishable from *E. hastata* by curved spire and more eccentric aperture. The specimens described were identified by Dr. Dall.

One specimen each from the lower San Pedro series at Deadman Island and the upper San Pedro series at San Pedro. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Acapulco (Carpenter).

Pleistocene.—San Pedro (Oldroyd; Arnold).

282. **Eulima hastata** *Sowerby*.

PLATE IX, FIG. 9.

Eulima hastata SBY., Proc. Zool. Soc., 1834, p. 7. CPR., Brit. Assn. Rept , 1856, p. 335. TRYON, Man. Conch., Vol. VIII, p. 273, Pl. LXIX, fig. 39, 1886.

Shell small, slender, turreted; apex acute; whorls nine, flat, smooth; suture indistinct, not impressed; body-whorl angular below, short; aperture suboval, abruptly truncated in front.

Dimensions.—Long. 7.4 mm.; lat. 2.5 mm.; body-whorl 3.1 mm.; aperture 2 mm.; defl. 22 degrees.

Distinguishable by the short, angular base, and short, truncated aperture. In other respects like *E. micans*. Specimens identified by Dr. Dall.

Four found in upper San Pedro series at San Pedro; and one in the lower San Pedro series at Deadman Island. Found in the Pleistocene at Barlow's ranch, Ventura; and at Spanish Bight, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Gulf of California; Ecuador (Carpenter).

Pleistocene.—San Pedro; Ventura; San Diego (Arnold).

283. **Eulima micans** *Carpenter*.

Plate IX, Fig. 12.

Eulima micans Cpr., Brit. Assn. Rept., 1863, p. 659. Reeve, Conch. Icon., p. 33, 1865. Tryon, Man. Conch., Vol. VIII, p. 272, Pl. LXIV, figs. 29, 30, 1886. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 240. Keep, West Coast Shells, p. 50, fig. 32, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 209.

Shell small, turreted, glossy; apex acute; whorls ten, flat; body-whorl convex; suture distinct, not impressed; aperture elongate-ovate; outer lip thin, rather arcuate; inner lip slightly incrusted.

Dimensions.—Long. 12 mm.; lat 3.2 mm.; defl. 25 degrees.

Distinguishable from *E. falcata* by straight spire and less bulging outer lip; distinguishable from *E. hastata* by even convexity of body-whorl. The specimens described were identified by Dr. Dall.

Found in the lower San Pedro series at Deadman Island and San Pedro, and in the upper San Pedro series at Crawfish George's, Los Cerritos, and San Pedro. The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold. Found also in the Pleistocene at Barlow's ranch, Ventura, and at Spanish Bight, San Diego.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

Family LXIV. PYRAMIDELLIDÆ.[1]

Genus **Turbonilla** *Risso*.

Turbonilla Risso, Hist. Nat. Eur. Merid., Vol. IV, p. 224, 1826. Type, *Turbonilla typica* Dall & Bartsch, =*Turbonilla plicatula* Risso, 1826, *non Turbo (=Turbonilla) plicatulus* Brocchi, 1814.

Shell with sinistral nucleus, slender, having many whorls, with axial[2] or spiral sculpture, or both; columella straight or twisted, usually with a single fold, which is rarely obsolete; operculum horny, subspiral, with spiral striæ on its outer surface.

Animal with wide, flattened tentacles; mentum elongated, flattened, and bilobed in front; foot large, short, auriculated anteriorly.

---

[1] The portion of the text relating to this family has been prepared, under the supervision and with the assistance of W. H. Dall, by Paul Bartsch, aid in the United States National Museum.

[2] Sculpture following the direction of the coil of the whorls is in these diagnoses referred to as *spiral*. That at right angles to the spiral sculpture, or in general parallelism with the axis of the shell, is called *axial*. An endeavor has been made to include all the Pleistocene species known from California, some of which, though found at San Diego, have not yet been obtained at San Pedro.

The species of this genus are distributed in all seas. All our West American forms have the columellar fold internal and hardly to be seen without breaking away part of the whorls.

The number of species is so great, and they are so similar to one another, that a number of sections, based chiefly on the types of sculpture, have been found convenient in treating of them. Most of these sections grade into one another through peripheral species.

Section *Strioturbonilla Sacco.*

Strioturbonilla SACCO, I. Moll. del Piedmonte e della Liguria, p. 94, 1892.

Shell as in *Chemnitzia*, but very finely and closely spirally striated on the spire and base.

Type, *Strioturbonilla alpina* Sacco, *l. c.*

284. **Turbonilla (Strioturbonilla) muricata** *Carpenter.*

Chemnitzia muricata CPR., Mazatlan Cat., Brit. Assn. Rept., 1856, p. 260.

Shell small, slender, solid, rather thin, milk-white; nuclear whorls two and one-half, helicoid, smooth, one-third sunken, their axis being at right angles to the axis of the post-nuclear whorls; post-nuclear whorls flattened, ornamented by eighteen to twenty-two very prominent, elevated, convex-topped, slightly oblique axial ribs, which extend to the suture posteriorly, but fuse just before reaching the suture anteriorly; ribs on body-whorl fuse abruptly at angle; the intercostal spaces appear as deep channels about as wide as the ribs; the suture appears very distinct, owing to a sharp angulation on the upper part of the whorl, and a slight contraction at the base; body-whorl rather short, rounded, smooth on base, except for fine, incremental lines; aperture subquadrate, the outer lip meeting the columella at almost right angles.

Dimensions.—Long. 5.4 mm.; lat. 1.3 mm.; altitude of body-whorl, 1.7 mm.

This species resembles *T. stearnsii*, but may be distinguished from that species by more elevated, narrower and more numerous ribs and by the stronger angulation above. The specimen examined lacked prominent spiral sculpture as far as the writer was able to determine. This specimen was identified by Dr. Dall, but the species was omitted from the text prepared by Dall and Bartsch.

Rather common in the upper San Pedro series of San Pedro and Los Cerritos; rare in the lower San Pedro series at Deadman Island and San Pedro.

Living.—Gulf of California to Mazatlan (Carpenter).

Pleistocene.—San Pedro (Arnold).

285. **Turbonilla (Strioturbonilla) similis** *C. B. Adams.*

Chemnitzia similis C. B. ADS., Catalogue Panama Shells, No. 228, Ann. N. Y. Lyc. Nat. Hist., Vol. V, 1852, p. 392.

Shell small, slender, solid, milk-white, thick; nuclear whorls two and one-half, smooth, helicoid, about one-third sunken, their axis being at right angles to the axis of the post-nuclear whorls; post-nuclear whorls nine, somewhat flattened, ornamented by fourteen to eighteen prominent, broad, convex, oblique, axial ribs, which traverse nearly the whole of the exposed portion of the whorls, but fuse anteriorly before reaching suture; the ribs are bent slightly forward near their posterior extremity; intercostal spaces deep, narrow; spiral sculpture fine but conspicuous; the sutures are deeply impressed, with smooth sides, caused by the fusion of the ribs before reaching the sutures; body-whorl rounded, smooth below, except for minute incremental lines and spiral ornamentation. Aperture subquadrate; the outer lip joins the straight, somewhat revolute columella at a right angle.

Dimensions.—Long. 5 mm ; lat. 1.1 mm.; altitude of body-whorl 1.4 mm.

This species somewhat resembles *T. stearnsii*, but is distinguishable from that species by the less number and greater prominence of the ribs, which in some cases bend slightly forward near their posterior extremity. *T. similis* was identified by Dr. Dall; but the species was omitted from the text prepared by Dall and Bartsch.

Rare in the lower San Pedro series at Deadman Island and San Pedro; common in the upper San Pedro series at San Pedro and Los Cerritos.

Living.—Gulf of California to Panama (Carpenter).

Pleistocene.—San Pedro (Arnold).

286. **Turbonilla (Strioturbonilla) stearnsii** *D. & B.*, sp. nov.

PLATE II, FIGS. 5 AND 5*a*.

Shell milk-white, rather stout; nuclear whorls two, small, helicoid, their axis being at right angles to the axis of the post-nuclear whorls; post-nuclear whorls very slightly convex, almost flattened, somewhat contracted at the base, and strongly shouldered at the summit, traversed by eighteen to twenty-six oblique, flexuose, axial ribs, which render the summits of the whorls wavy; intercostal spaces deep, terminating a little above the periphery, thus leaving a narrow, plain band above the suture, as in *T. torquata stylina*; the entire surface of the whorls is marked by numerous faint, wavy, spiral striations, which also ornament the otherwise plain basal portion of the last whorl; suture well defined, slightly channeled; aperture subovate, anterior angle obtuse; outer lip thin, joining the short, somewhat revolute columella in a gentle curve.

Dimensions.—Long. 9.2 mm.; diam. 2.3 mm.

The type, which has eleven and one-half post-nuclear whorls, is from the post-Pliocene of San Diego.

This species in a general way resembles *T. torquata stylina*, but differs from it in being much more robust, of greater diameter throughout, and in having the fine, wavy sculpture characteristic of the section.

Turbonilla (Strioturbonilla) stearnsii occurs quite abundantly in the post-Pliocene deposits at San Diego and San Pedro. It also occurs recent in the Gulf of California. The name is proposed in honor of Dr. R. E. C. Stearns of Los Angeles, who collected many specimens of this group.

287. **Turbonilla (Strioturbonilla) torquata** *Gould.*

PLATE II, FIGS. 4 AND 4*a*.

Chemnitzia torquata GLD., Bost. Jour. Nat. Hist., Vol. IV, 1853, p. 384, Pl. XIV, fig. 16.

Shell slender, solid, milk-white, entire surface marked by faint, wavy, spiral striations; nuclear whorls three, helicoid, their axis being at right angles to and to one side of the post-nuclear whorls; post-nuclear whorls somewhat flattened, ornamented by sixteen to twenty-two broad, oblique, somewhat flexuose axial ribs, which traverse five-sixths of the exposed portion of the whorls, then fuse, leaving a band above the suture and the base of the last whorl devoid of sculpture; the intercostal spaces appear as grooves gouged out of the shell, their bases marking the fusing point of the ribs; they are equal to the ribs in breadth; the sutures are well defined, owing to the very slight shouldering of the summit and the slight contraction of the base of the whorls; last whorl slightly angular at the periphery; aperture subovate; the rather thick outer lip joins the straight, somewhat revolute columella at almost a right angle.

Dimensions.—Long. 10.6 mm.; diam. 2.5 mm.

The specimen figured is from the post-Pliocene of San Diego.

This species occurs living along the California coast at present, but appears far more abundant in the fossil state. More than five hundred individuals referable to this form have been examined, only six of which were recent, the remainder being post-Pliocene fossils from the vicinity of San Pedro and San Diego.

288. **Turbonilla (Strioturbonilla) torquata**, var. **stylina** *Carpenter*.

PLATE I, FIGS. 10 AND 10*a*.

Chemnitzia (? torquata var.*) stylina* CPR., Ann. Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 396.

Shell like *T. torquata*, but more slender, with but two nuclear whorls; having more axial ribs, twenty-two to twenty-eight on the post-nuclear whorls, and the intercostal spaces extending further down upon the whorls, thus diminishing the breadth of the plain band above the sutures; entire surface marked by faint, wavy, spiral striations.

Dimensions.—Long. 8 mm.; diam. 1.9 mm.

The specimen figured is from Monterey. This variety has been found as far north as Port Etelces, Alaska. It occurs abundantly as a post-Pliocene fossil in the vicinity of San Pedro and San Diego.

Section *Lancea Pease*.

Lancea PEASE, Am. Journ. Conch., Vol. III, 1867, p. 293. Type, *Turbonilla* (*Lancea*) *elongata* PEASE, =*Pyrgostylus* MONTEROSATO, Conch. Medit., p. 90, 1884.

Turbonillas with strong axial ribs and spiral sculpture, provided with thickened varices at irregular intervals on the spire, which are usually accompanied by internal lirations of the outer lip.

289. **Turbonilla (Lancea) aurantia** *Carpenter*.

Chemnitzia tridentata (? var.) *aurantia* CPR., Brit. Assn. Rept., 1863, p. 659; Jour. de Conch., Vol. XII, 1865, p. 147.

Shell small, slender, solid, rather thick, reddish-brown; first three post-nuclear whorls convex, five remaining post nuclear whorls (nearly) flat; whorls ornamented by twenty to twenty-six broad, evenly rounded, only very slightly oblique axial ribs, which extend nearly from suture to suture; the intercostal spaces appear as narrow grooves, their width is much less than the width of the ribs; the spiral striations on the base and between the ribs are very faint; the sutures are well defined and deep, owing to a distinct shouldering of the whorls above, and an equal contraction of the whorl at the base; last whorl slightly angular at the periphery, base of this whorl smooth except for very fine axial, incremental lines, and nearly obsolete spiral striations; aperture subquadrate, the thick outer lip joins the nearly straight, somewhat revolute columella at almost a right angle.

Dimensions.—Long. 6 mm.; lat. 1.8 mm.; body-whorl, altitude 2 mm.

This species somewhat resembles *T. tridentata* in general appearance, but may be distinguished from that species by the greater number of ribs, which are closer together and broader, the narrower interspaces and fewer whorls. The specimen described lacks the nuclear whorls, which were broken off; the spiral sculpture on this specimen is also very faint, and would have been overlooked if a very high-power magnifier had not been used. This specimen was identified by Dr. Dall; but the species was omitted from the text prepared by Dall and Bartsch.

Rare in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at Los Cerritos and San Pedro.

Living.—Puget Sound to Santa Barbara (Carpenter): San Pedro (Williamson).

Pleistocene.—San Pedro (Arnold).

290. **Turbonilla (Lancea) tridentata** *Carpenter.*

PLATE II, FIGS. 1 AND 1*a*.

Chemnitzia tridentata CPR., Jour. de Conch., Vol. XIII (3rd Ser., Vol. V), 1865, p. 147.

Shell large, broad; chestnut colored, obscurely banded; nuclear whorls three, helicoid, about one-third immersed, scarcely extending beyond the margin of the spire, their axis being at a right angle to the axis of the later whorls; post-nuclear whorls slightly convex, somewhat contracted below and slightly shouldered at the summit; traversed by about twenty to twenty-four strong, well-rounded, somewhat oblique axial ribs, which continue faintly over the decidedly angular periphery of the last whorl and the base to the umbilical region; these ribs are considerably enfeebled on the last whorl of old shells and frequently become almost obsolete on these; the exposed portion of the whorls is traversed by six to ten spiral grooves, which appear most prominently in the shallow and broad intercostal spaces, and less so on the ribs; these deep spiral lines are regularly spaced, leaving a broader interval on the middle of the exposed portion of the whorl; the base of the last whorl is likewise ornamented by spiral grooves, but here they appear less developed than on the spire; in addition to this the entire surface of the shell is marked by numerous very fine, somewhat wavy, spiral and axial striæ, which show most prominently on the last whorl and base, and give the shell a very minutely reticulated secondary sculpture; at irregular intervals the whorls are marked by thick callous varices, which are usually of a lighter color than the remainder of the shell; aperture large, subquadrate; posterior angle acute; outer lip thin, having three strong internal lirations, joining the whitish, short, straight, revolute columella at a little less than a right angle; by transmitted light two spiral, light color-bands become apparent on the inside of the lip, each of which is bordered by a zone of a darker color than the remaining shell; the general color effect of the exterior is that of a flesh-colored shell, covered by a dark epidermis, which is stretched tight over the ribs, permitting the lighter color beneath to shine through it at their summits.

Dimensions.—Long. 11.1 mm.; diam. 3.2 mm. (Dr. Carpenter's type, collected at Monterey, and having 11 post-nuclear whorls). Long. 12.8 mm.; diam. 3.6 mm. (Specimen figured, which is from San Pedro).

Fossil specimens from the post-Pliocene of California are larger, have fewer ribs, and more of the deep revolving lines than recent ones.

291. **Turbonilla (Lancea) pentalopha** *D. & B.*, sp. nov.

PLATE I, FIGS. 1 AND 1 *a*.

Shell chocolate-brown, inflated, stubby; nuclear whorls three, helicoid, moderately large, about one-third immersed, their axis being at a right angle to the axis of the later whorls; post-nuclear whorls at first a little rounded, later flattened, scarcely contracted at base, shouldered at the summit, adorned by twenty to twenty-eight strong, rounded, slightly oblique and somewhat flexuose axial ribs, which pass over the periphery of the last whorl and gradually disappear on the base; intercostal spaces rather deep, marked by five or six narrow, deep, subequally spaced spiral grooves, which encroach upon the ribs and in places extend over them; base of the last whorl very short, abruptly rounded, depressed at the umbilical region, marked by seven equally-spaced spiral striæ of the same nature as those of the exposed portion of the preceding whorls, the first one above and the first one below the periphery are a little farther apart than the rest and map out the path for the shoulder of the succeeding whorl; aperture large, ovate; outer lip thin, meeting the short, somewhat twisted and revolute columella in a broad curve; the reflexing of the thin columella and the sudden curving of the base cause the shell to appear subumbilicate.

By transmitted light the ribs become apparent on the inside of the outer lip, and the spiral striæ appear as so many faint red bands; at irregular intervals five strong spiral liræ are developed on the inside of the outer lip, the upper four being equally spaced, the fifth or anterior one being a little closer to its neighbor; no varices appear to accompany the internal lirations, a character in which it differs from typical *Lancea*.

Dimensions.—Long. 8.5 mm.; diam. 2.3 mm.

The type, which is figured, was collected at San Diego, and has ten post-nuclear whorls.

Recent specimens appear to range from San Pedro to Lower California. Fossils of this species have been found at Deadman Island.

Section *Pyrgiscus Philippi.*

Pyrgiscus PHIL., Weig. Arch., Bd. VII, 1841, p. 50. Type, *Melania rufa* PHIL., l. c. = *Pyrgostelis* MONTEROSATO, Conch. Medit., p. 89, 1884.

Turbonillas having prominent axial ribs and spiral sculpture, but no varices or internal lirations; columella usually somewhat flexuous.

[S. D.] **Turbonilla (Pyrgiscus) auricoma** *D. & B.*, sp. nov.

PLATE I, FIGS. 4 AND 4*a*.

Shell slender, attenuated, brown, lighter on the early whorls, becoming quite dark on the last; nuclear whorls two and one-half, large, helicoid, not immersed, projecting somewhat beyond the outline of the spire, their axis being at a right angle to the axis of the later whorls; post-nuclear whorls at first somewhat rounded, later flattened. traversed by eighteen to twenty-four strong, moderately wide axial ribs, inclined slightly toward the aperture; these continue quite prominently over the well-rounded periphery and base of the last whorl to the umbilical region; intercostal spaces somewhat irregular in width, deep, ornamented by about eight moderately deep, wavy, spiral striæ, which are red in color; whorls slightly contracted at base and shouldered at the summit, which is rendered wavy by the ribs; suture quite prominent; the base of the last whorl is well rounded, inflated, and ornamented by nine subequally spaced spiral striæ of a similar character to those of the exposed portions of the whorl; aperture large, ovate, somewhat produced at the base; posterior angle acute; outer lip thin, joining the oblique, strongly revolute columella in a wide curve; the strongly reflexed columella and the decided rounding of the last whorl give the shell a subumbilicated appearance; the peritreme is rendered almost complete by the strong callus which extends from the posterior angle of the aperture to the insertion of the columella; by transmitted light the interior of the outer lip appears beautifully marked by narrow, wavy, sometimes branching, spiral threads of red, laid on a ground of pale yellow, the middle one of which is the broadest, and marks the periphery.

Dimensions.—Long. 7.2 mm.; diam. 1.9 mm.

The type is from Scammon's Lagoon, Lower California, and has twelve post-nuclear whorls.

This species also occurs recent along the California coast, and has been found as a post-Pliocene fossil at San Diego.

292. Turbonilla (Pyrgiscus) latifundia *D. & B.*, sp. nov.

PLATE III, FIGS. 5 AND *5a*.

Shell very broadly conic, milk-white; nuclear whorls two and one-half, with moderately elevated spire, extending a little beyond the outline of the first post-nuclear whorl on one side, about one-third immersed, their axis being at a right angle to the axis of the later whorls; post-nuclear whorls well rounded, each much broader at its base than the summit, ornamented by about fourteen strong, rounded, oblique, axial ribs and seven or eight deeply impressed, very prominent spiral lirations, extending across the intercostal spaces, which are about twice as wide as the ribs, and upon the sides of these, but they do not cross their summits; both ribs and intercostal spaces pass very feebly over the decidedly angulated periphery (this angulation is much more pronounced in young specimens than in the adult); the short base is marked by about seven continuous, somewhat wavy, subequally spaced, spiral lines, much weaker than the spiral sculpture on the exposed portion of the whorls; aperture subquadrate, posterior angle acute; outer lip thin, showing the external sculpture within by transmitted light; columella straight and revolute.

Dimensions.—Long. 5.8 mm.; long. spir. 5.2 mm.; diam. 2 mm.

The type is a post-Pliocene fossil from San Pedro, and has nine post-nuclear whorls.

This species occurs also in the post-Pliocene deposits of Deadman Island. So far no recent representatives have been found.

293. Turbonilla (Pyrgiscus) tenuicula *Gould.*

PLATE II, FIGS. 7 AND *7a*.

Chemnitzia tenuicula GLD., Bost. Jour. Nat. Hist., Vol. VI, 1853, pp. 383, 384, Pl. XIV, fig. 15.

Shell small, elongated, lanceolate, turreted, rather solid, shining, wax yellow, a little dusky below the suture; whorls ten, flat, slightly shouldered above, marked by about twenty direct, longitudinal folds, the summits of which are cut by numerous fine revolving striæ, deeper in the interstices, which also extend over the base of the shell, though the folds terminate at the periphery, or are extended in delicate furrows; aperture narrow, ovate; lip sharp; revolving striæ apparent within.

Dimensions.—Length 7.5 mm.; diam. 1.3 mm.

Found at Santa Barbara.

The above is the original description by Gould. *Turbonilla (Pyrgiscus) tenuicula* Gould is the most abundant and most variable species of all the west American forms, presenting many varieties or incipient species; to describe these would not aid science or the collector, but would only add to the confusion which this paper is intended to dispel. The following comprehensive description will embrace, we believe, all the forms coming under this name:—

Shell slender to somewhat stubby and inflated, varying in color from milk-white to waxy yellow or to dark brown, variously banded or plain monocolored; nuclear whorls three, moderately large, planorboid, slightly slantingly immersed; post-nuclear whorls rounded to flattened, contracted at base and strongly shouldered at the summit, traversed by eighteen to twenty-eight strong axial ribs, which are excurved and usually somewhat thickened, and connected at their summits, which appear beaded; these ribs extend feebly over the rounded base of the last whorl; the entire shell is crossed by spiral lines, ten to sixteen or more of which appear on the exposed portion of the whorls, and more, closer placed, wavy ones on the base of the last whorl; the suture is deep, subchanneled and wavy; aperture ovate, produced at base; outer lip thin, meeting the oblique, slightly curved and revolute columella in a broad curve; a faint callus connects the posterior angle of the aperture with the insertion of the columella.

Dimensions.—Long. 6.5 mm.; diam. 1.9 mm.

The specimen figured is from the Todos Santos Bay, Lower California, and has nine post-nuclear whorls. One of the same number of whorls from San Pedro measures: long. 6.2 mm; diam. 1.7 mm.

Recent specimens in our collection range from Monterey to Todos Santos Bay, Lower California. The species occurs also in the post-Pliocene beds at San Diego and San Pedro.

294. **Turbonilla (Pyrgiscus) crebrifilata** *Carpenter.*

PLATE II, FIGS. 6 AND 6*a*.

Chemnitzia crebrifilata CPR., Ann. Mag. Nat. Hist., 3d Ser., Vol. XV, 1865, p. 395.

Shell milk white to waxy yellow to yellowish brown in color, and of similar shape to *T. tenuicula* Gld.; nuclear whorls three, helicoid, slantingly one-third immersed; extending a little beyond the outline of the spire on one side; post-nuclear whorls at first well rounded, later flattened, strongly shouldered at the summit and ornamented by eighteen to twenty-four very pronounced, acute and somewhat flexuous, irregularly slanting axial ribs, which are outcurved at the summit of the whorl and there held in union by a spiral thickening of the wavy shoulder; intercostal spaces moderately deep and very broad, at least double the width of the ribs, with a quite deep depression immediately below the shoulder, which causes the summits of the whorls to appear crenulate, and ornamented by about eight to ten spiral striations of varied width and spacing; these striations frequently extend over the ribs and cause the intermediate ground to appear as raised ridges; suture deep and wavy; periphery and base of the last whorl well rounded, the axial ribs extending faintly over the base to the umbilical region; the base is marked by spiral striations similar to those of the exposed portion of the whorls, but here they are more wavy and adjacent; aperture ovate, rather large, acute posterior angle, and the base somewhat produced; outer lip thin, meeting the oblique, somewhat twisted and revolute columella in a gentle curve; a faint callus extends from the posterior angle of the aperture to the pillar. By transmitted light a broad, white, revolving band becomes apparent in the peripheral region of the aperture in dark-colored specimens.

Dimensions.—Long. 5.4 mm.; diam. 1.6 mm.

The specimen figured has nine post-nuclear whorls. Fossil specimens from the post-Pliocene of California attained a much larger size than recent representatives of the species. A fragment of a specimen collected at San Diego, consisting of the last four whorls, has a diameter of 2.2 mm.

295. **Turbonilla (Pyrgiscus) subcuspidata** *Carpenter.*

PLATE II, FIGS. 2 AND 2*a*.

Chemnitzia subcuspidata CPR., Proc. Cal. Acad. Sci., Vol. III, 1865, p. 220, No. 670.

Shell stout, strong, somewhat inflated, whitish to waxy yellowish; nuclear whorls three, helicoid, of moderate size, slantingly one-fourth immersed, slightly extending beyond the general outline of the spire on one side; post-nuclear whorls well rounded, the last two somewhat flattened, contracted at base, outcurved and muricated at their summits, traversed by sixteen to twenty very strong, flexuose, more or less irregular axial ribs, which extend strongly upward and render the shoulder subcuspidate and very wavy; these ribs become enfeebled on the last whorl and almost obsolete on the base, extending only very feebly over the well rounded periphery to the umbilical region; intercostal spaces wider than the ribs, undulating, traversed by five to twelve deep spiral striations, which extend less prominently over the ribs and cause the whorls to appear as if they were wound by a series of overlapping bands of varied width; these bands vary in number and consequently in width, being fewer and most prominent on the earlier whorls, as are the ribs, later on becoming enfeebled; a very slight groove passes about the periphery of the last whorl and maps out the route for the suture; the spiral sculpture of the entire last whorl is very regular, there being about thirteen subequally spaced striæ above the periphery and eighteen on the base; the sutures are very deep, subchanneled; aperture ovate; posterior angle acute; outer lip moderately thick, rather effuse at base, joining the oblique, somewhat reflexed columella in a gentle curve; a faint callus connects the posterior angle of the aperture with the insertion of the columella; by transmitted light a faint, light, revolving band becomes apparent in the peripheral region within the aperture.

Dimensions.—Long. 6 mm.; diam. 2 mm.

The specimen figured and described is Dr. Carpenter's type; it has eight and one-half post-nuclear whorls, and comes from San Diego. Fossil specimens from the same locality are even more robust. One of seven post-nuclear whorls measures: long. 5.6 mm.; diam. 2.1 mm. Found in the post-Pliocene deposits of San Pedro.

Section *Pyrgisculus Monterosato.*

Pyrgisculus MONTEROSATO, Conch. Medit., p. 88, 1884. Type, *Melania scalaris* PHILIPPI.

Turbonillas with strong axial ribs and lamellate spiral sculpture, having a decidedly sloping shoulder at the summit.

296. **Turbonilla (Pyrgisculus) laminata** *Carpenter.*

PLATE II, FIGS. 8 AND 8*a*.

Dunkeria laminata CPR., Ann. Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 396.

Shell white to dark brown, plain or variously banded; nuclear whorls three, large, tumid, helicoid, slantingly slightly immersed; post-nuclear whorls well rounded, ornamented by twenty-two to twenty-eight strong axial folds, which pass feebly over the well-rounded periphery and base of the last whorl to the umbilical region, and five very strong, broad, flat, subequally spaced spiral ridges, which give the spire a reticulated, pitted pattern; the portions between the ribs and the spiral folds appear as small, deep pits of a more or less circular outline, while the ribs appear thickened where they are crossed by the spiral bands; a sixth spiral band maps out the path for the shoulder of the succeeding whorl on the periphery of the basal whorl, while the base proper is marked by about eight spiral striations, which are strongest at the periphery and gradually weaken toward the umbilicus; the whorls are marked by a quite prominent sloping shoulder, which extends from the first revolving band to the summit; the suture is deep, subchanneled; aperture broadly ovate, somewhat effuse, with the posterior angle acute; outer lip thin, crenulate by the spiral ridges, meeting the curved and revolute columella in a broad curve; a thin callus extends from the posterior angle of the aperture to the umbilical region.

Dimensions.—Long. 6.8 mm.; diam. 2.2 mm.

The specimen figured is from San Pedro, and has nine whorls.

Post-Pliocene specimens from California are usually larger, though quite identical in every other respect. One of nine post-nuclear whorls measures: long. 8.6 mm.; diam. 2.4 mm. The smallest forms come from Lower California. One of eight post-nuclear whorls measures: long. 4.9 mm.; diam. 1.6 mm.

Section *Pyrgolampros Sacco.*

Pyrgolampros SACCO, I Moll. del Piedmonte e della Liguria, p. 85, 1892. Type, *P. mioperplicatulus* SACCO.

Turbonillas with more or less weak axial ribs, which always almost disappear as they pass over the periphery and base of the last whorl, and many very fine, faint spiral striations; columella usually somewhat flexuous.

297. **Turbonilla (Pyrgolampros) lowei** *D. & B.*, sp. nov.

PLATE I, FIGS. 5 AND *5a*.

Shell of medium size, light golden brown; nuclear whorls three, small, helicoid, partly slantingly immersed; post-nuclear whorls very similar to those of *T. vancouverensis* Baird, in outline, moderately convex, strongly contracted at base and moderately so at the summit, bounded by a prominent suture. The early whorls increase less rapidly in diameter than the later ones, and are ornamented by more and weaker axial ribs than the later ones; these ribs slant toward the aperture; beginning with the sixth whorl the shell assumes a more robust character, the whorls become broader and are ornamented by twenty to twenty-two strong, somewhat flexuose, almost vertical axial ribs, which extend faintly over the angular periphery of the last whorl to the umbilical region; the entire shell is traversed by many very fine, very closely placed spiral striæ; aperture subrhomboid, outer lip thin, produced and flaring at its junction with the twisted and revoluted columella.

Dimensions.—Long. 7.2 mm.; diam. 2.2 mm.

The type is from San Pedro, and has ten and one-half whorls. Specimens from the post-Pliocene of California are larger and more robust. One of ten normal whorls measures: long. 8.1 mm.; diam. 2.4 mm. Fossil specimens occur abundantly at San Pedro and San Diego.

This species is named in honor of Mr. H. N. Lowe, of Long Beach, California, to whom we are indebted for material bearing on our study of these difficult little shells.

[S. D.] **Turbonilla (Pyrgolampros) lowei, var. pedroana** *D. & B.*, var. nov.

PLATE II, FIGS. 3 AND 3*a*.

Shell similar to *T. lowei*, both in general form and sculpture, but more robust, broader and less attenuate; nuclear whorls three, half immersed; post-nuclear whorls with ribs of more uniform size, not crowded and enfeebled on the early whorls as in *T. lowei;* basal portion of the whorls of a darker color than the upper, causing the exposed portion of the whorls to appear banded above the suture; whorls faintly shouldered, otherwise as in *T. lowei.*

Dimensions.—Long. 7 mm.; diam. 2.3 mm.

The type has nine post-nuclear whorls. Specimens from Victoria, B. C., are still broader. One of seven post-nuclear whorls measures: long. 5.5 mm.; diam. 2.1 mm. The northern specimens are also somewhat lighter in color. This variety is found living from Victoria, B. C., to San Diego, and occurs fossil in the post-Pliocene beds at San Diego.

298. **Turbonilla (Pyrgolampros) arnoldi** *D. & B.*, sp. nov.

PLATE I, FIG. 7.

Shell whitish, robust, more or less inflated; nuclear whorls decollated; post-nuclear whorls flattened, somewhat contracted at base, and slightly outcurved at the summit, traversed by about twenty-two to twenty-eight more or less irregular axial ribs, slanting slightly toward the aperture, and which extend less prominently over the well-rounded periphery of the last whorl to the umbilical region; suture deep, subchanneled, somewhat undulate; the entire surface of the whorls is covered with fine, very closely placed, wavy, spiral striations; last whorl somewhat produced; aperture large, subovate, with a thin outer lip, which is decidedly effuse at base, and meets the somewhat oblique and revolute columella in a broad curve.

Dimensions.—Long. 7.6 mm.; diam. 2.3 mm.

The specimen figured has eight post-nuclear whorls.

This species so far has only been reported from the post-Pliocene deposits of Deadman Island. It is named in honor of Mr. Ralph Arnold, of Pasadena, California.

299. **Turbonilla (Pyrgolampros) gibbosa** *Carpenter.*

PLATE I, FIGS. 2 AND 2*a*.

Chemnitzia gibbosa CPR., Cat. Maz. Shells, p. 430, No. 525, 1857.

Shell inflated, robust, broad and stumpy, of light, fulvous coloration; nuclear whorls deeply immersed, very slightly exposed at the tip, their axis apparently being at a right angle to the axis of the later whorls; post-nuclear whorls flattened, somewhat contracted at the periphery and rounded at the summit, traversed by about sixteen to twenty-four broad, coarse, irregularly slanting axial ribs, which extend over the inflated periphery of the last whorl to the umbilical region, appearing less prominent on the base; the entire surface of the shell is covered by very minute, close, spiral striation; suture subchanneled and wavy; aperture ovate, outer lip thin, joining the twisted and revolute columella in a broad curve.

Dimensions.—Long. 5.6 mm.; diam. 2.1 mm.

The specimen figured has seven post-nuclear whorls.

This is certainly the most unattractive member of the genus. Dr. Carpenter described it as a recent form in his Catalogue of Mazatlan Shells. We have a single recent specimen from Monterey. It appears to be more abundant in the post-Pliocene deposits of Deadman Island.

300. **Turbonilla (Pyrgolampros) adleri** *D. & B.*, sp. nov.

PLATE I, FIG. 9.

Whorls decidedly flattened, contracted at the periphery and shouldered at the summit; axial ribs only faintly indicated near the summit of the whorls by distant, shallow, impressed lines, which mark their lateral margins; the entire shell is traversed by faint, closely placed, wavy, spiral striations; suture quite deep, subchanneled; periphery of the last whorl rounded; aperture subrhomboidal, posterior angle obtuse; columella reflexed, strongly twisted, giving it the appearance of being provided with a broad, rounded fold; a faint callus connects the columella with the posterior angle of the aperture.

Dimensions.—Long. 9.3 mm.; diam. 3.2 mm.

Only two fragments of this specimen have so far come to our notice; both are from the post-Pliocene deposits of Deadman Island.

The type consists of the last six post-nuclear whorls. It may, however, have had eleven whorls normally.

Genus **Pyramidella** *Lamarck*.

Shell turriculated, spire elevated, axially ribbed; columella with three anterior plications; outer lip sharp, sometimes plicate within.

Pyramidella plicata Lamarck is a characteristic species.

301. **Pyramidella conica** *Adams*, var. **variegata** *Carpenter*.

Obeliscus variegata CPR., Brit. Assn. Rept., 1863, p. 658; Ann. Mag. Nat. Hist., 3rd Ser., Vol. XIV, 1864, p. 46. KEEP, West Coast Shells, p. 54, fig. 35, 1892.

Pyramidella conica ADS., var. *variegata* CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 208.

Shell small, elongate-conical; spire elevated; apex acute; whorls ten, flat, smooth; suture distinct; aperture subovate; outer lip thin; columella truncated, with three plications.

Dimensions.—Long. 13 mm.; lat. 3.6 mm.; defl. 20 degrees.

Rare in upper San Pedro series of San Pedro; one specimen. This species was omitted from the text prepared by Dall and Bartsch. In examining some *Turbonillas* in the collection of Mr. Henry Hemphill the writer found one of this species labeled "*Turbonilla mexicana* Dall and Bartsch." This name is the one under which it probably should appear, but not having an opportunity to consult Dr. Dall on the subject, this note is appended.

Living.—San Diego; Lower California (Carpenter).

Pleistocene.—San Pedro (Arnold).

Genus **Odostomia** *Fleming.*

Odostomia FLEMING, Edinburgh Encyclopedia, Vol. VII, Pt. I, p. 76, 1817 ? (*ex parte*).
Type, *Odostomia plicata* MONT.

Shell with sinistral nucleus, subglobose to broadly conic; spire rarely elevated as in *Turbonilla*; sculpture varying in the different sections from plain (*Odostomia*, s. s.) to highly ornamented (*Chrysallida*); columella provided with a single fold, which is rarely obsolete.

Animal as in *Turbonilla*. The species of this genus are distributed in all seas. The original description of this genus included chiefly small land shells, with dentate apertures, but also a few marine species. The land shells had already received names, so the marine species were left to carry Fleming's name, a fact recognized by him in later publications. The rarity of the original edition of the Edinburgh Encyclopedia has made it very difficult to ascertain the facts in regard to this genus, and the true date of its publication, but we believe the facts to be now established as above stated. The species cited in the original publication are *O. interstincta*, *O. unidentata*, *O. plicata*, *O. sandvicensis* and *O. insculpta*.

Section *Odostomia Fleming, s. s.*

Odostomia FLEMING, Edinburgh Encyclopædia, Vol. VII, Pt. I, p. 76, 1817 (*ex parte*).
Type, *Odostomia plicata* MONT.

Odostomias of more or less conical outline, devoid of all sculpture, except incremental lines, and having a more or less prominent columellar fold.

302. **Odostomia tenuis** *Carpenter.*

PLATE I, FIG. 14.

Odostomia tenuis CPR., Cat. Maz. Shells, p. 412, 1856.

Shell slender, conic, umbilicated, dingy white; nuclear whorls small, immersed; post-nuclear whorls very slightly convex, almost flattened, scarcely contracted at base, and hardly shouldered; suture not very prominent, hardly channeled; base and periphery of the last whorl well rounded; aperture quite large, ovoid, posterior angle acute, outer lip somewhat contracted at its middle; columella very flexuous, slender and revolute; parietal wall covered by a faint callus; columellar fold strong opposite the umbilical chink.

Dimensions.—Long. 5.7 mm.; diam. 2.6 mm.

The specimen figured is from Santa Rosa Island, California, and has seven post-nuclear whorls.

The species appears to range in the recent state from Washington to California, and has been found in the post-Pliocene deposits of San Diego, San Pedro, and Ventura.

Section *Evalea A. Adams.*

Evalea A. ADAMS, Ann. Mag. Nat. Hist., 3d Ser., Vol. VI, 1860, p. 22. Type, *Odostomia (Evalea) elegans* A. ADAMS.

Ondina DE FOLIN, Fonds de la Mer, p. 214, 1870. Type, *Ondina sulcata* DE FOLIN, l. c.

Odostomias without axial sculpture, having spiral striation or liration.

[S. D.] **Odostomia (Evalea) stearnsii** *D. & B.*, sp. nov.

PLATE 1, FIG. 12.

Shell regularly elongate-conic, turreted, subumbilicated, milk white; nuclear whorls small, slantingly immersed; post-nuclear whorls rounded, somewhat contracted at base and strongly shouldered at the summit; suture profound, channeled; last whorl rather inflated; aperture large, pyriform, posterior angle obtuse, outer lip slightly contracted at the middle; columella decidedly oblique, flexuous and reflexed, the narrow parietal wall being covered by a faint callus; a weak columellar fold appears opposite the umbilical chink; the entire shell is ornamented with very fine spiral striation.

Dimensions.—Long. 5.2 mm.; diam. 2.2 mm.

The type has eight post-nuclear whorls, and is from the post-Pliocene of San Diego, which is the only locality, so far, from which this species has been reported.

303. **Odostomia (Evalea) gouldii** *Carpenter.*

PLATE I, FIG. 15.

Odostomia (? var.) *gouldii* CPR., Ann. Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 30.

Shell solid, inflated, shining, subdiaphanous to milk-white; nuclear whorls obliquely immersed; post-nuclear whorls rounded, not contracted at base, and but very feebly shouldered at the summits; base and periphery of the last whorl well rounded; aperture large, ovoid, posterior angle acute; outer lip well rounded, its anterior margin somewhat effuse at the junction with the twisted, reflexed and appressed columella; columellar fold very prominent a little anterior to the upper end of the columella; the entire shell is very feebly and closely spirally striated.

Dimensions.—Long. 5 mm.; diam. 2.8 mm.

The specimen figured has six post-nuclear whorls, and comes from Monterey. The species ranges recent from Alaska to San Diego, Cal., occurring as a post-Pliocene fossil in the last-named place, and also at San Pedro and Ventura.

Section *Amaura Möller.*

Amaura MÖLLER, Index Moll. Groenl., p. 7, 1842. Type, *A. candida* MÖLLER, l. c.

Odostomias of extremely large size, inflated, very heavy, usually devoid of all sculpture, sometimes very minutely spirally striated.

This genus was supposed to be naticoid, but an examination of the authentic specimens shows its relations to be with the Pyramidellidæ. The account of the animal in Fischer's Manual appears to have been taken from a true naticoid, perhaps *Amauropsis*, which Fischer wrongly includes as a section under *Amaura*; but this account does not agree with Möller's original diagnosis, nor with the characters of *Amaura*, as determined from specimens collected in Greenland by Möller, which show, when the back of the shell is ground away, the plait invisible from in front of the aperture.

[S. D.] **Odostomia (Amaura) pupiformis** *Carpenter.*

PLATE I, FIG. 13.

Odostomia satura var. *pupiformis* CPR., Ann. Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 30.

Shell broadly conic, umbilicated, rather thin, white, shining, of rather rough exterior; nuclear whorls immersed; post-nuclear whorls somewhat rounded and shouldered at the summit; suture deep and channeled; base and periphery of the last whorl decidedly rounded; aperture large, broadly ovate; posterior angle acute; outer lip somewhat effuse in its anterior margin; columella thin and flexuose, provided with a prominent oblique fold a little anterior to the umbilicus; a weak callus covers the parietal wall.

Dimensions.—Long. 6.4 mm.; diam. 3.3 mm.

The type was collected at Neeah Bay, Washington, and has six post-nuclear whorls. The strong umbilication and the light weight of the shell enable one to distinguish it quite readily from all the other forms of this section. The species ranges recent from Alaska to San Diego. Fossil specimens have been found in the post-Pliocene beds of San Diego.

304. **Odostomia (Amaura) nuciformis, var. avellana** *Carpenter.*

PLATE I, FIG. 11.

Odostomia (? var.) *avellana* CPR., Ann. Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 30.

Shell large, stout and inflated, white; nuclear whorls small, immersed; post-nuclear whorls somewhat rounded, rather broad, marked only by thin lines of growth; sutures quite prominent, subchanneled; base and periphery of the last whorl well rounded; aperture large, subovate; posterior angle obtuse; outer lip somewhat contracted, while the anterior margin is somewhat effuse; columella short and flexuose, provided with a strong, broad fold just anterior to the umbilical chink; a strong callus extends from the posterior angle of the aperture to the base of the columella and renders the peritreme almost continuous.

Dimensions.—Long. 9.1 mm.; diam. 4.4 mm.

This is one of the large West Coast *Odostomias*, and ranges in the recent state from Alaska to San Pedro. The specimen figured is from Neeah Bay, Washington, the type locality. It has six post-nuclear whorls.

Fossil forms occur in the post-Pliocene deposits of Deadman Island, and also at Ventura.

O. avellana differs from true *O. nuciformis* in having the spire much more elongated; it is therefore less pudgy than that form.

Section *Chrysallida Carpenter.*

Chrysallida CPR., Cat. Maz. Shells, p. 416, 1857. Type, *Chrysallida communis* C. B. ADAMS.

Odostomias having strong axial ribs, crossed by equally strong spiral sculpture, which renders the spire nodulose; the axial ribs pass only faintly over the base, while the spiral sculpture remains quite prominent.

[S. D.] **Odostomia (Chrysallida) diegensis** *D. & B.*, sp. nov.

PLATE I, FIG. 8.

Shell elongate-conic, dingy white; nuclear whorls decollated; post-nuclear whorls flattened, contracted at base and strongly shouldered at the summit; suture undulate, profoundly channeled; about seventeen very strong, rounded, axial ribs cross the third and fourth, and twenty-two the penultimate whorl; these ribs pass faintly over the well-rounded periphery of the last whorl to the umbilical region; the first five whorls are encircled by four strong, spiral ridges, while the penultimate shows an additional one; these ridges are not quite as broad as the axial ribs, but extend prominently over them and the intercostal spaces; base ornamented by about ten spiral ridges of weaker character than those of the spire, and by the faint extensions of the axial ribs; aperture suboval, decidedly produced and flaring at the junction of the outer lip with the columella (outer lip fractured in all our specimens); columella somewhat twisted and reflexed, a bit being broken away at the umbilical region in the type, disclosing a small umbilical chink which is opposite to the strong columellar fold; a heavy callus connects the posterior angle of the aperture with the columella.

Dimensions.—Long. 4 mm.; diam. 1.6 mm.

The seven specimens of this species in our collection all come from the post-Pliocene deposits at San Diego. The type has seven post-nuclear whorls.

Section *Oscilla A. Adams.*

Oscilla A. ADAMS, Proc. Zool. Soc., 1867, p. 310. Type, *Odostomia* (*Evalea*) *lirata* A. AD.

Odostomias having strong spiral ribs, the spaces between which are ornamented by numerous fine, raised, axial threads.

[S. D.] **Odostomia (Oscilla) æquisculpta** *Carpenter.*

PLATE I, FIGS. 3 AND 3*a*.

Odostomia (Evalea) æquisculpta CPR., Ann. Mag. Nat. Hist., 3d Ser., Vol. XIV, 1864, pp. 46, 47.

Shell small, quite solid, elongate-ovate, subdiaphanous to white; nuclear whorls three, obliquely one-third immersed; post-nuclear whorls rounded, separated by a prominent suture and ornamented by about five fairly strong and rounded, subequally spaced spiral ridges on the second, and six above the periphery on the penultimate whorl; the base of the last whorl is similarly sculptured, the striations becoming fainter near the columella; the depressed spaces between the revolving ridges are beautifully, closely crossed by fine axial riblets; periphery of the last whorl well rounded; aperture large and effuse at base, posterior angle acute, outer lip thin, somewhat arcuate; columella stout, provided with a small fold near the umbilical chink; a faint callus unites the posterior angle of the aperture with the upper end of the columella; the external sculpture is apparent within the aperture by transmitted light.

Dimensions.—Long. 2 mm.; diam. 1.2 mm.

The specimen here described and figured is Dr. Carpenter's type. It was collected at Cape St. Lucas, Lower California.

This species occurs quite abundantly as a recent form, ranging from San Pedro, California, to Cape St. Lucas. It is also found in the post-Pliocene deposits of San Diego.

The type is an immature specimen. One specimen comprising seven post-nuclear whorls measures: long. 5 mm.; diam. 1.8 mm.

[S. D.] **Odostomia (Oscilla) grammatospira** *D. & B.*, sp. nov.

PLATE I, FIGS. 6 AND 6*a*.

Shell elongate-conic, subdiaphanous to milk white; nuclear whorls three, one-half obliquely immersed; post-nuclear whorls flattened, traversed by four very strong, flattened, decidedly raised spiral ridges, which are separated by furrows of about the same width; the sutures being marked by a little wider groove than those between the spiral ridges; the spiral depressions are very finely and closely axially ribbed; the base of the last whorl is ornamented by similar sculpture, but of a weaker character, the spiral ridges diminish gradually in size and at the same time approach each other more closely, vanishing altogether on the extreme base; aperture subrhombic, posterior angle acute, outer lip thin, arcuate, very much produced and flaring at the junction with the pillar; columella stout, reflexed, provided with a prominent fold at its insertion.

Dimensions.—Long. 5.3 mm.; diam. 2.1 mm.

The type has eight post-nuclear whorls. It was collected at Cape St. Lucas, Lower California. Two fossil specimens in our collection from the post-Pliocene beds of San Diego are referable to this species.

Subgenus **Ivara** *D. & B.* (mss.)

Odostomias characterized by the spiral striation and tabulated whorls.

305. **Odostomia (Ivara) terricula** (*Carpenter*) *D. & B.*

PLATE IV, FIG. 14.

Ivara terricula CPR. (mss.), D. & B., 1901.

Shell minute, ovate, thin; spire elevated; apex acute; whorls five, convex, shouldered above; surface sculptured by fine, spiral ridges and obsolete transverse ribs, more prominent near top of whorls; suture deeply impressed; body-whorl over half length of shell; shouldered above, evenly convex below; aperture truncated above, evenly rounded below; outer lip thin, extending around and up on columella, forming a small columellar plication.

Dimensions.—Long. 4 mm.; lat. 1.8 mm.; body-whorl 2.6 mm.; aperture 1.5 mm.

This delicate little shell is easily recognized by its shouldered whorls and delicate spiral sculpture. Specimen identified by Dr. Dall; but the species omitted from the text prepared by Dall and Bartsch.

Rare in lower San Pedro series of Deadman Island. One specimen, which is figured, and is now in the collection of Delos Arnold.

Living.—Mexican Coast (Dall).

Pleistocene.—San Pedro (Arnold).

Superfamily TÆNIOGLOSSA.

Family LXV. TRITONIDÆ.

Genus **Tritonium** *Link.*

Shell oblong; spire prominent; whorls with a few remote and non-continuous varices; columella rough or smooth; canal recurved, short or long; outer lip internally crenated or denticulated.

Tritonium variegatus Lam. is a characteristic species.

306. Tritonium gibbosus *Broderip*.

Triton gibbosus BROD., Proc. Zool. Soc., 1833, p. 7, Pl. VII. KUSTER, Conch. Cab., p. 69, fig. 7. TRYON, Man. Conch., Vol. III, p. 23, Pl. XII, fig. 103, 1881. COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part III, 1894, p. 32.

Shell small, subfusiform; whorls five, subtriangular, strongly angulated, giving tabular appearance to the upper part of whorls; prominent rounded, nodose varices at about every two-thirds of a revolution, with two or three nodes on angle of whorl in intervening spaces; suture reaching nearly to columella, giving a staircase appearance to the spire; surface ornamented with small, revolving ridges made rugose by incremental lines; aperture subcircular; outer lip slightly corrugated internally; inner lip smooth, incrusted; canal long, narrow, curved slightly back; umbilicus subperforate.

Dimensions.—Long. 41 mm.; lat. 22 mm.; body-whorl 28 mm.; aperture 10 mm.; canal 11 mm.; defl. 56 degrees.

A unique shell, the only one of its genus so far recorded as occuring fossil in California.

Rare in upper San Pedro series of San Pedro; one specimen found. Dr. Dall also reports one found in the bay at this place, which he thinks is a fossil that had been weathered out of the Pleistocene beds.

Living.—West tropical America; Panama (Cooper).

Pleistocene.—San Pedro (Dall; Arnold).

Subgenus Priene *H. & A. Adams*.

Shell ventricose, thin, cancellated or plicated; canal short; operculum with apical initial point.

307. Tritonium (Priene) oregonensis *Redfield*.

PLATE VI, FIG. 1.

Triton oregonense REDF., Ann. N. Y. Lyc., Vol. IV, 1846, p. 165, Pl. XI, figs. *2a*, *2b*. GLD., Wilkes' Expl. Exped., Vol. XII, p. 241, 1852.

Fusus oregonensis REDF., REEVE, Icon. Conch., No. 61, figs. 61*a-b*, 1848.

Triton (Priene) oregonensis REDF., CPR., Brit. Assn. Rept., 1863, p. 661.

Tritonium (Priene) oregonensis REDF., GABB, Pal. Cal. Vol. II, p. 73, 1869.

Tritonium oregonense REDF., DALL, Proc. U. S. Nat. Mus., Vol. IX, 1887, p. 212.

Priene oregonensis REDF., COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 261. KEEP, West Coast Shells, p. 44, 1892.

Priene cancellatus LAM. (*fide* TRYON, Man. Conch., Vol. III, p. 34, Pl. XVI, figs. 164-167; Pl. XVII, figs. 170-172, 1881) (pars).

Shell large, fusiform; spire elevated; apex blunt; whorls eight to ten, convex; nuclear whorls smooth, except for obsolete spiral striations; cancellated sculpture of nearly equally prominent spiral and transverse rounded ridges; suture deeply impressed; discontinuous rounded varices at every half to two-thirds revolution on upper whorls; aperture subovate; outer lip not thickened, slightly effuse on adult shells; canal long, narrow, recurved; inner lip incrusted; columella slightly twisted; umbilicus obsolete.

Dimensions.—Long. 103 mm.; lat. 48.5 mm.; body-whorl 71 mm.; aperture 31 mm.; canal 21 mm.; defl. 47 degrees.

Young shells look much like certain species of *Triton* on account of varices. Common in the Pliocene of Deadman Island; rarer in the lower San Pedro series at Deadman Island, and only occasionally found in the upper San Pedro series at Deadman Island, San Pedro, and Crawfish George's. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to Monterey; Japan (Cooper): dredged off San Diego (Raymond): Kodiak Island (Snodgrass).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Ranella** *Lamarck.*

Shell ovate or oblong, compressed, with two rows of continuous varices, one on each side; aperture oval; columella arcuated and ridged, or crenulated; canal short, recurved; outer lip crenated.

Ranella spinosa Lam. is a characteristic species.

308. **Ranella californica** *Hinds.*

Ranella californica HDS., Ann. Nat. Hist., Vol. II, 1843, p. 255; Voyage Sulphur, p. 12, Pl. II, figs. 3 and 5, 1844. CPR., Brit. Assn. Rept., 1863, p. 661. TRYON, Man. Conch., Vol. III, p. 40, Pl. XXI, fig. 32; Pl. XXII, fig. 42, 1881. GABB, Pal. Cal., Vol. II, p. 73, 1869. KEEP, West Coast Shells, p. 44, fig. 24, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 211.

Shell large, broadly fusiform; spire elevated, about one-half length of aperture; whorls five, convex, each with two prominent, rounded, rather reflexed varices, each set forming a continuous varix from apex to base; between varices are one or two prominent rows of rounded nodes, each row having from one to four, and numerous rugose revolving ridges of varying prominence; suture deeply impressed, distinct; aperture subovate; outer lip thickened, ridged, denticulated; inner lip incrusted, the spiral ornamentation sometimes showing through the incrustation; columella curved, flattened, widened; canal short.

Dimensions.—Long. 90 mm.; lat. 67 mm.; body-whorl 70 mm.; aperture, including canal, 53 mm.; defl. 76 degrees.

This shell is easily distinguishable by its size and general solid appearance. Rare in the upper San Pedro series of San Pedro; three perfect specimens found; one fine specimen from the upper San Pedro series of Los Cerritos; also found at Deadman Island and Crawfish George's in the same horizon. Found in the Pleistocene at Pacific Beach, San Diego.

Living.—Santa Barbara to Lower California (Carpenter).

Pleistocene.—Santa Barbara; San Pedro (Gabb): San Pedro; San Diego (Arnold).

Pliocene.—Kirker's Pass.

Family LXVI. CYPRÆIDÆ.

Genus **Cypræa** *Linné.*

Shell ventricose, convolute, covered with shiny enamel; spire concealed; aperture long and narrow, with a short canal at each end; inner lip crenulated; outer lip inflected and crenulated.

Cypræa argus Linn. is a characteristic species.

309. **Cypræa spadicea** *Gray.*

Cypræa spadicea SWAINSON, Tillock's Phil. Mag., Vol. LXI, 1823, p. 376; Exotic Conchology, Pl. CLXXXII. TRYON, Man. Conch., Vol. VII, p. 182, Pl. XIII, fig. 78, 1885.

Cypræa spadicea GRAY, Monog. Cypræidea, Zool. Jour., London, Vol. I, 1824, p. 71. DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 207.

Luponia spadicea GRAY, CPR., Brit. Assn. Rept., 1863, p. 657. KEEP, West Coast Shells, p. 59, fig. 43, 1892.

Luponia spadicea SWAIN., GABB, Pal. Cal., Vol. II, p. 78, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 247.

Shell of medium size, pyriform, ventricose, convolute; spire concealed; surface covered with shining reddish brown enamel in living shell (in the fossil obtained at San Pedro this is worn and subdued); aperture long and narrow, with a short canal at each end, the anterior canal being the longer; outer lip inflected and crenulated; inner lip crenulated.

Dimensions.—Long. 50 mm.; lat. 33 mm.; altitude, when lying aperture down, 25 mm.

Specimen identified by Dr. Dall.

One specimen from the upper San Pedro series of Deadman Island found by Mrs. Oldroyd, and one from the upper San Pedro series at the lumber yard, San Pedro, found by Delos Arnold.

Living.—Santa Barbara to San Diego and Lower California (Cooper).

Pleistocene.—Santa Barbara Island (Cooper): San Pedro (Oldroyd; Arnold).

Genus **Trivia** *Gray.*

Small shells with striæ extending over the back, where they are frequently interrupted by an impressed dorsal sulcus.

Trivia quadripunctata Gray is a characteristic species.

310. **Trivia californica** *Gray.*

Trivia californica Gray, CPR., Brit. Assn. Rept., 1863, p. 657. KEEP, West Coast Shells, p. 60, figs. 44, *a*, *b*, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 207.

Shell small, semiglobular; convex surface crossed by eight or nine transverse ridges, which are interrupted on the center of the shell by a slight depression running longitudinally; sloping surface of ends ornamented with several ridges that radiate from the ends of the dorsal depression; aperture narrow, curved; outer and inner lip denticulated by elongated, sharp teeth, the continuations of the transverse ridges.

Dimensions.—Long. 8 mm.; lat. 6.5 mm.; alt. 5 mm.

Only a few specimens found in the upper San Pedro series of San Pedro.

Living.—Santa Barbara to Lower California (Carpenter).

Pleistocene.—San Pedro (Arnold).

311. **Trivia solandri** *Gray.*

Trivia solandri GRAY, CPR., Brit. Assn. Rept., 1863, p. 657. KEEP, West Coast Shells, p. 60, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 207.

Shell, small, ventricose, convolute; spire concealed; about thirteen elevated lines cross the back of the shell; these lines are interrupted in the middle of the shell by an impressed median sulcus, along the sides of which the transverse lines end in rounded nodes; the sulcus does not extend to either end of the shell; aperture long and narrow, with a canal at each end; inner lip crenulated; outer lip inflected and crenulated.

Dimensions.—Long. 12.5 mm.; lat. 9.5 mm.; height, when lying on aperture, 7 mm.

This species is distinguishable from *T. californica* by its much larger size, coarser sculpture and impressed median sulcus.

One specimen from the lower San Pedro series of Deadman Island.

Living.—Santa Barbara to Panama (Carpenter).

Pleistocene.—San Pedro (Arnold).

Genus **Erato** *Risso.*

Shell obovate, polished; spire short, conical, distinct; aperture linear; outer lip without varix, but thickened toward the middle, and denticulated within; columella with distinct plates at the forepart.

Erato lævis Donov. is a characteristic species.

312. **Erato columbella** *Menke.*

Erato columbella MKE., Zeit. Mal., p. 183, No. 26. 1847. CPR., Brit. Assn. Rept., 1863, p. 657. TRYON, Man. Conch., Vol. V, p. 10, Pl. IV, fig. 8, 1883. KEEP, West Coast Shells, p. 61, fig. 46, 1892. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 240. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 207.

Shell small, pyriform; spire only slightly elevated; whorls four, nearly flat, except body-whorl, which is ventricose and pyriform, and comprises most of the shell; surface smooth; suture distinct; aperture long, narrow, curved around body-whorl; outer lip finely dentate within.

Dimensions.—Long. 7 mm.; lat. 4 mm.; body-whorl 6.5 mm.; aperture 6 mm.

One specimen from upper San Pedro series of San Pedro.

Living.—Monterey to San Diego; Mazatlan (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Family LXVII. TRIFORIDÆ.

Genus **Triforis** *Deshayes*.

Shell sinistral, sculptured, granular; whorls numerous, terminating below in a small aperture, with tubular anterior canal; opposite this canal is sometimes a second one upon a varix, marking the position of a former aperture.

Triforis perversus Linn. is a characteristic species.

313. **Triforis adversa** *Montagu*.

Triforis adversa MONT., Test. Brit., p. 271, 1803. CPR., Brit. Assn. Rept., 1863, p. 660. TRYON, Man. Conch., Vol. IX, p. 187, Pl. XXXIX, fig. 51, 1887. KEEP, West Coast Shells, p. 47, 1892.

Shell sinistral, with cancellated sculpture, caused by three spiral and numerous equally as prominent transverse ridges; resembles *Bittium rugatum* somewhat in sculpture.

One imperfect specimen from lower San Pedro series at Deadman Island collected by Mrs. Oldroyd.

Living.—Vancouver to Santa Barbara Island (Carpenter).

Pleistocene.—San Pedro (Oldroyd).

Superfamily CERITHIACEA.

Family LXVIII. CERITHIOPSIDÆ.

Genus **Seila** *A. Adams*.

Shell spiral, elongated, many whorled, frequently varicose; aperture channeled in front, with a less distinct canal posteriorly; outer lip not reflected; nuclear whorls sinistral; transversely lirate.

314. **Seila assimilata** *C. B. Adams*.

PLATE IV, FIG. 8.

Cerithiopsis assimilata C. B. AD., Maz. Cat., No. 563, 1852. CPR., Brit. Assn. Rept., 1863, p. 660. TRYON, Man. Conch., Vol. IX, p. 174, Pl. XXXVI, fig. 59, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 232. KEEP, West Coast Shells, p. 48, 1892.

Shell small, thin, turreted; nuclear whorls sinistral; whorls ten, ornamented with three prominent, sharp, equal, equidistant, raised spiral lines; interspaces between ridges crossed by numerous fine liruke; suture indistinct, not distinguishable on upper portion of spire; base truncated abruptly, flat; aperture subquadrate; outer lip thin, not effuse; inner lip simple; columella recurved; canal short.

Dimensions.—Long. 10 mm.; lat. 3.8 mm.; body-whorl 3.8 mm.; aperture 2.1 mm.; defl. 24 degrees.

Resembles the *Bittiums*, but is distinguishable by the strong spiral lines. Specimen identified by Dr. Dall. Rare in lower San Pedro series at San Pedro.

The specimen figured was obtained from the lower San Pedro series at San Pedro, and is now in the private collection of Delos Arnold.

Living.—Monterey to Panama (Cooper): Catalina Island, 20 fathoms (Arnold, 1901).

Pleistocene.—San Pedro (Oldroyd; Arnold): San Diego (Cooper).

Family LXIX. CERITHIIDÆ.

Genus **Bittium** *Leach.*

Shell elevated, with numerous granular whorls and irregular varices; anterior canal short, not recurved; inner lip simple; outer lip not reflected, usually with an exterior rib.

Bittium reticulatum Da Costa is a characteristic species.

315. **Bittium asperum** *Gabb.*

Turbonilla aspera GABB, Proc. Phil. Acad. Nat. Sci., 1861, p. 368.

Bittium asperum GABB, CPR., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XVII, 1866, p. 276. GABB, Pal. Cal., Vol. II, p. 72, Pl. II, fig. 20, 1869. TRYON, Man. Conch., Vol. IX, p. 153, Pl. XXX, fig. 7, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 230.

Bittium asperum CPR., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205.

Shell small, slender, turreted; apex elevated, acute; whorls nine to ten, nearly flat on posterior portion, with prominent angulation anteriorly; sculpture consists of three spiral ridges, crossed by sixteen to eighteen much more prominent ridges; suture deep, distinct; aperture semi-elliptical, with prominent basal emargination instead of a canal; lip thin, inner side crenulated; body-whorl angulated, base slightly sculptured spirally.

Dimensions.—Long. 10.5 mm.; lat. 31 mm.; aperture 2.5 mm. x 1.5 mm.; defl. 22 degrees.

This species may be distinguished by the relative prominence of its transverse sculpture. Specimens identified by Dr. Dall

Common in the Pliocene at Deadman Island and Timm's Point; rare in the lower San Pedro series of Deadman Island, and found only occasionally in the upper San Pedro series of Crawfish George's and San Pedro. Found in the Pleistocene at bath-house, Santa Barbara; at Barlow's ranch, Ventura; and at Pacific Beach, San Diego.

Living.—Santa Barbara to Catalina Island (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; Santa Barbara; San Diego (Arnold).

Pliocene.—San Diego well (Dall): San Pedro (Arnold).

316. **Bittium californicum** *Dall & Bartsch.*

PLATE IV, FIG. 4.

Bittium (*Elachista*) *californicum* DALL & BARTSCH, Nautilus, Sept., 1901, p. 58.

Shell, small, thin, white, turreted; spire elevated, mammilliform apex; whorls eight, convex, slightly more angular on anterior portion of whorl; whorls crossed by twelve or thirteen prominent, rounded, equal, equidistant ridges; spiral sculpture hardly visible; suture deeply impressed, distinct; aperture subrotund; outer lip thin, smooth; columella smooth; body-whorl angulated at the base; base shows spiral lines.

Dimensions.—Long. 6 mm.; lat. 2.2 mm.; body-whorl 2.5 mm.; aperture 1 mm.; defl. 24 degrees.

This species, with the possible exception of *B. williamsoni*, is the smallest of the Pleistocene *Bittiums* of this locality, and is easily distinguishable by its size and the faintness of its spiral sculpture. Several specimens show a slightly less deflection than the one figured. Specimen identified by Dr. Dall.

Rare in the lower San Pedro series at San Pedro. The specimen figured, which was found in the lower San Pedro series at San Pedro, is now in the collection of Delos Arnold.

Pleistocene.—San Pedro (Arnold).

317. Bittium filosum *Gould.*

Cerithium filosum GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1849. p. 120; Wilkes' Expl. Exped., Vol. XII, p. 149, fig. 175, 1852.

Bittium filosum GLD.. CPR., Brit. Assn. Rept., 1863, p. 655. TRYON, Man. Conch., Vol. IX, p. 152, Pl. XXIX, fig. 90, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 230. KEEP, West Coast Shells, p. 72, fig. 57, 1892.

Shell small, slender, turreted; apex elevated, acute; whorls eight, flat, slightly angulated near anterior margin, and ornamented with four alternating ridges and grooves of about equal width; apical whorls transversely sculptured; base of body-whorl sculptured in same way; suture deep, distinct; aperture small, semielliptical, with basal emargination instead of a canal; lip thin, with interior ridges corresponding to exterior grooves.

Dimensions.—Long. 8.5 mm.; lat. 2.9 mm.; aperture 2 mm. x 1.2 mm.; defl. 20 degrees.

This species is distinguishable by its lack of transverse ornamentation. The specimen described was identified by Dr. Dall.

Specimens of this species are rather rare in both the lower and upper San Pedro series at San Pedro and Deadman Island; a few found at Crawfish George's.

Living.—Sitka to Monterey (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

318. Bittium quadrifilatum *Carpenter.*

PLATE IX, FIG. 2.

Bittium quadrifilatum CPR., Brit. Assn. Rept., 1863, p. 655; Jour. de Conch., Vol. XII, 1865, p. 143. TRYON, Man. Conch., Vol. IX, p. 153, Pl. XXIX, fig. 91, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 230. KEEP, West Coast Shells, p. 72, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205, Pl. XXI, fig. 4.

Shell small, turreted, elongate; apex acute; whorls ten or eleven, nearly flat; body-whorl slightly ventricose; surface sculptured by four more or less prominent spiral ridges, and on upper whorls by transverse ridges; these ridges become obsolete on the penultimate and body-whorls in adult specimens, leaving only the spiral lines on these whorls; suture distinct, impressed, giving a keeled appearance to the lower portion of the whorl in some specimens; aperture subquadrate; outer lip thin; columella truncate, spirally sculptured without.

Dimensions.—Long. 10 mm.; lat. 2.5 mm.; defl. 18 degrees.

This species is intermediate between *B. filosum* and *B. asperum*, having the sculpture of the former on the body-whorl and the sculpture of the latter on the apical whorls, while the intermediate whorls have a gradation sculpture. Specimens identified by Dr. Dall.

Not uncommon in the lower San Pedro series at Deadman Island and San Pedro; rare in the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, and Crawfish George's. Found in the Pleistocene at the bath-house, Santa Barbara.

The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara (Arnold).

One of the laws of evolution is that of acceleration of development, which has been formulated by Alpheus Hyatt,[1] as follows:—

"All modifications and variations in progressive series tend to appear first in the adolescent or adult stages of growth, and then to be inherited at earlier and earlier stages, according to the law of acceleration, until they either become embryonic or are crowded out of the organization, and replaced in the development by characters of later origin."

This means that theoretically each organism in its ontogeny, or life history, ought to go through stages of growth corresponding to all of its ancestors, and that these stages ought to appear in the order of its ancestral forms. This law is exemplified by the genetic series, consisting of *B. asperum*, *B. quadrifilatum* and *B. filosum*.

First, we have *B. asperum*, which is the only species of this genus found in the Pliocene at Deadman Island. It has a characteristic nodose-cancellate sculpture, caused by two series of ridges, spiral and transverse, and this sculpture extends back from the body-whorl through the intermediate to the apical whorls. Thus, in this species the same characteristic sculpture is found in the larval stage (which is represented by the apical whorls), the adolescent stage (intermediate whorls), and in the adult stage, which is represented by the penultimate and body-whorls.

Next we have *B. quadrifilatum* (Plate IX, fig. 2), which is first found in the lower San Pedro beds of the Pleistocene, and which, it is reasonable to suppose, developed out of *Bittium asperum*. At any rate, this species is not found in the Pliocene, but is quite abundant in the lower San Pedro. The sculpture of this species is as follows: Apical whorls nodose-cancellate; intermediate whorls with the transverse sculpture becoming less prominent as the whorls become larger; penultimate and body-whorl generally with four prominent spiral threads or ridges, but with transverse sculpture obsolete. It is thus seen that the *asperum* sculpture is found in the intermediate and apical whorls. That is, the cancellate sculpture, or, more properly speaking, the transverse sculpture, has been gradually forced back toward the earlier stages of growth, and is wholly lost in the adult stages of *B. quadrifilatum*.

---

[1] A. Hyatt, "Genesis of the Arietidæ," Preface, p. ix.

The next species in the series is *B. filosum*. This species is found very sparingly in the lower San Pedro, and although not common in the upper San Pedro, is noticeably more abundant in this later horizon than in the one preceding. Its separation from *B. quadrifilatum* no doubt began early in the Pleistocene, but this type did not reach a full development until the time of the upper San Pedro. The sculpture of this species consists primarily of spiral ridges or raised lines. This to the naked eye seems to be the only sculpture in typical specimens, but with the aid of a microscope the apical whorls are seen to have quite prominent transverse ridges, giving them (with the spiral ridges) a cancellate or *asperum* sculpture. Thus we see that the sculpture developed in the adult *B. asperum* is forced out of the adult stages and back into the adolescent stages, while in *B. filosum* we have the same sculpture occurring only in the apical whorls, or larval stage. As the larval period is the earliest in which we may study the shell of the gastropod, we may reasonably suppose that in the next marked period of development this cancellate sculpture would be completely lost, leaving only the typical *B. filosum*, or spiral sculpture, to ornament the whole shell from its larval to its adult stage, unless new characteristics of sculpture were developed in the meantime.

The spiral sculpture has been the persistent character in this series, while the transverse has been nearly lost by being forced back further and further toward the embryonic stage in succeeding individuals, until we have it remaining only in the very earliest whorls of *B. filosum*.

It is true that all three of these species are living at the present day, and that the transverse sculpture has persisted in certain individuals up to the present time, but they are sufficiently differentiated to call by different specific names. It is evident that in the case of the *Bittiums* under discussion, the development of what we call species has been brought about, not so much by the acquiring of certain specific characteristics, as by the gradual loss of a certain characteristic already possessed by the ancestral form.

TABLE SHOWING DEVELOPMENT OF SCULPTURE.

	Larval stage, apical whorls.	Adolescent stage, intermediate whorls.	Adult stage, penultimate and body-whorl.
B. filosum (Upper San Pedro).......	spiral and weak transverse.	spiral.	spiral.
B. quadrifilatum (Lower San Pedro)..	spiral and transverse.	spiral and weak transverse.	spiral.
B. asperum (Pliocene)...........	spiral and transverse.	spiral and transverse.	spiral and transverse.

319. **Bittium rugatum** *Carpenter.*

PLATE IV, FIG. 11.

Bittium rugatum CPR., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XVII, 1866, p. 276.

Shell small, turreted; spire elevated; apex acute; whorls ten to eleven, flat; numerous transverse ridges, crossed by a varying number of nearly equally prominent spiral ridges, produce a nodose-cancellated sculpture; the spiral ridges increase in number on the anterior whorls; suture very deeply impressed, forming a sutural canal; body-whorl angulated, base ornamented with fine spiral and transverse lines; aperture subrectangular; outer lip thin, smooth; columella incrusted; canal short.

Dimensions.—Long. 13 mm.; lat. 5 mm.; body-whorl 6 mm.; aperture 3.5 mm.; defl. 23 degrees.

This species is quite variable in sculpture, owing to the varying number of spiral ridges on different individuals. The specimen described was identified by Dr. Dall.

Common in the lower San Pedro series at Deadman Island and San Pedro, and in upper San Pedro series at Deadman Island, Crawfish George's, Los Cerritos, and San Pedro. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Catalina Island to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

320. **Bittium williamsoni**, sp. nov.

PLATE VI, FIG. 11.

Shell small, elongate, turreted; whorls seven, angular, flat and sloping above, straight below; upper surface of whorl minutely cancellate with fine spiral and transverse ridges; lower surface with two prominent spiral ridges and faint transverse ribs; suture deeply impressed, distinct; aperture circular; base smooth; basal angle rounded slightly.

Dimensions.—Long. 2.5 mm.; lat. 1 mm.

This is the smallest of the *Bittiums* found in the San Pedro deposits, and is distinguishable by its small size, prominently turbinated apex, and prominent cancellated sculpture. The specimen figured is the type, which was identified as a new species by Dr. Dall, and which is now in the United States National Museum.

Found in the upper San Pedro series of San Pedro. Also found in the Pleistocene at Spanish Bight, near San Diego.

Living.—(*Ubi?*) (Dall).

Pleistocene.—San Pedro (Arnold).

Subgenus **Styliferina** *A. Adams.*

Diaphanous; conical turreted; whorls smooth, convex; apex mucronate; aperture subquadrate; inner lip straight.

Bittium orthochila A. Ads. is a characteristic species.

321. Bittium (Styliferina) tenuisculpta *Carpenter.*

PLATE VI, FIG. 14.

Shell small, conical, turreted, thin, diaphanous; apex sharp; whorls ten, rounded, nearly smooth, but showing faint spiral sculpture; suture deep, distinct; body-whorl evenly rounded below; aperture subrotund; outer lip thin; inner lip simple.

Dimensions.—Long. 5 mm.; lat. 2 mm.; body-whorl 2.5 mm.; aperture 7.5 mm.; defl. 20 degrees.

Specimens identified by Dr. Dall.

Rare in lower San Pedro series of San Pedro; one specimen found, which is figured, and is now in the collection of Delos Arnold.

Living.—West Coast (?).

Pleistocene.—San Pedro (Arnold).

Genus **Diastoma** *Deshayes.*

Shell turreted; whorls with numerous transverse ribs, and with a few intermediate varices; inner margin of the aperture partially detached from the previous whorl; the aperture itself is strongly contracted posteriorly.

322. Diastoma, sp. indet.

Shell small, regularly conical, turreted; whorls seven, convex, ornamented with eleven slightly oblique transverse ridges, which are most prominent on the angle of the whorl and become obsolete at the sutures; suture deeply impressed; aperture broadly elliptical; outer lip thin; inner lip smooth; canal short.

Dimensions.—Long. 10.5 mm.; lat. 4.5 mm.; body-whorl 5.8 mm.; aperture, 4 mm.; defl. 28 degrees.

The above description was taken from a shell which Dr. Dall pronounced a young of the genus *Diastoma.*

Lower Pleistocene of San Pedro, only one specimen. A specimen of the same species (?) was found in the Pleistocene at the bath-house, Santa Barbara.

Pleistocene.—San Pedro; Santa Barbara (Arnold).

Genus **Cerithidea** *Swainson.*

Shell turriculated, longitudinally ribbed; whorls numerous; summit of spire more or less decollated; aperture rounded, slightly slit anteriorly; outer lip expanded, thickened, broadly rounded below, and usually produced into a beak crossing the sinus to the left.

Cerithidea decollatum Linn. is a characteristic species.

323. Cerithidea californica *Haldemann.*

Cerithium californicum HALD., Fr. W. Univ. Moll., cover of No. 1, 1840.

Cerithium (*Potamis*) *sacratum* GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1849, p. 118; Wilkes' Expl. Exped., Vol. XII, p. 114, Pl. X, fig. 116, 1852. TRYON, Man. Conch., Vol. IX, p. 162, Pl. XXXIII, figs. 69-72, 1887.

Cerithidea sacrata GLD., CPR., Proc. Zool. Soc., 1856, p. 226. KEEP, West Coast Shells, p. 71, fig. 56, 1892.
Cerithidea californica HALD., GABB, Pal. Cal., Vol. II, p. 79, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 233. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 277. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205.

Shell turreted; apex decollated; whorls nine or ten, slightly convex, ornamented with three or four spiral ridges and numerous transverse ridges, the two sets varying in prominence; suture impressed, distinct; aperture subquadrate; outer lip effuse, thickened, broadly rounded below, and slightly produced in a columellar beak; inner lip straight above this beak.

Dimensions.—Alt. 25 mm.; lat. 9.5 mm.; defl. 22 degrees.

This is the only representative of this genus, and is one of the commonest of the gastropods in the upper San Pedro formation.

Found in the Pliocene of Deadman Island, lower San Pedro series of Deadman Island and San Pedro, and upper San Pedro series of Crawfish George's, Los Cerritos, San Pedro, and Deadman Island. Found in the Pleistocene at Twenty-sixth Street and Pacific Beach, San Diego.

Living.—Baulinas Bay to San Diego; Mazatlan (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Fernando, Los Angeles County (Cooper): San Pedro (Arnold).

Family LXX. CÆCIDÆ.

Genus **Cæcum** *Fleming.*

Young shell spiral in one plane, afterwards an arcuated tube, truncated posteriorly by the loss of the spiral portion, and closed there by a convex septum or plug.

Cæcum cornuoides is a characteristic species.

324. **Cæcum californicum** *Dall.*

PLATE VIII, FIG. 6.

Cæcum cooperi CPR., Brit. Assn. Rept., 1863, p. 655; not of SMITH (*fide* DALL).
Cæcum californicum DALL, Proc. U. S. Nat. Mus., Vol. VIII, 1885, p. 541. TRYON, Man. Conch., Vol. VIII, p. 219, Pl. LXVI, fig. 65, 1886. KEEP, West Coast Shells, p. 73, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 299.

Shell small, tubular, curved, white, very slightly tapering; plug bent toward convex side; aperture circular, slightly contracted; surface ornamented by thirty to forty prominent, narrow, rounded rings.

Dimensions.—Long. (maximum) 3 mm.; lat. 0.9 mm.

Shell may be distinguished from *C. crebricinctum* by its small size and much more prominent, narrow, sharp rings.

Quite common in the upper San Pedro series of San Pedro and Crawfish George's, and in the lower San Pedro series of Deadman Island and San Pedro.

The specimen figured is from the lower San Pedro series at Deadman Island, and is now in the collection of Delos Arnold.

Living.—Santa Barbara Island to San Diego (Carpenter): Catalina Island, 20 fathoms (Arnold, 1901).

Pleistocene.—San Pedro (Arnold): San Diego (Stearns).

Pliocene.—San Quentin Bay, Lower California (Orcutt).

325. Cæcum crebricinctum *Carpenter.*

PLATE VIII, FIG. 10.

Cæcum crebricinctum CPR., Brit. Assn. Rept., 1863, p. 655; Proc. Cal. Acad. Sci., Vol. III, 1865, p. 215. TRYON, Man. Conch., Vol. VIII, p. 218, Pl. LXVII, fig. 71, 1886. KEEP, West Coast Shells, p. 73, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 300. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 204.

Shell small, white, curved, tubular, thin; ornamented with very fine, close, annular ring sculpture; plug subangulate, bent toward convex side.

Dimensions.—Long. 5.5 mm.; lat. 1 mm.

Distinguishable from *C. californicum* by its larger size and less prominent rings. The specimen described was identified by Dr. Dall.

Found in the lower San Pedro series of Deadman Island and San Pedro, and in the upper San Pedro series of San Pedro and Crawfish George's. The specimen figured is from the lower San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Monterey to San Diego (Carpenter): San Pedro (Williamson): Catalina Island, 20 fathoms (Arnold, 1901).

Pleistocene.—San Pedro (Arnold): San Diego; Coronado Beach (Dall).

Pliocene.—San Quentin Bay, Lower California (Orcutt).

326. Cæcum magnum *Stearns.*

PLATE VIII, FIG. 16.

Cæcum magnum STEARNS, TRYON, Man Conch., Vol. VIII, p. 219, Pls. LXVII, LXXXIII, 1886.

Shell small, tubular, curved, tapering; surface sculptured with numerous fine rings; aperture circular; plug sharp.

Dimensions.—Long. 5 mm.; latitude, base, 0.9 mm.; apex 0.3 mm.

This species resembles *C. crebricinctum*, but differs from that species in being more curved and in tapering much more rapidly from the anterior to the posterior extremity. Specimen identified by Dr. Dall. Tryon's figure may be of *C. crebricinctum*. One specimen from the lower San Pedro series of Deadman Island, which is figured, and is now in the collection of Delos Arnold.

Living.—?

Pleistocene.—San Pedro (Arnold).

Family LXXI. VERMETIDÆ.

Genus **Serpulorbis** *Sassi.*

Shell tubular, irregularly twisted, adherent; aperture rounded; columella not plicate.

Serpulorbis arenaria Quoy. is a characteristic species.

327. **Serpulorbis squamigerus** *Carpenter.*

Aletes squamigerus CPR., Proc. Zool. Soc., 1856, p. 226.

Serpulorbis squamigerus CPR., Brit. Assn. Rept., 1863, p. 654. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. KEEP, West Coast Shells, p. 74, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 204.

Vermetus squamigerus CPR., TRYON, Man. Conch., Vol. VIII, p. 181, Pl. LIV, figs. 73, 74, 1886.

Shell tubular, irregularly twisted, adherent; surface may be transversely or longitudinally ornamented, generally, however, only showing circular incremental lines; aperture circular.

Dimensions.—Diameter from 2 mm. to 15 mm.

In some cases found attached to rocks in conglomerate, in others found in irregular aggregates or individual sections.

Common in the upper San Pedro series of San Pedro and vicinity; rare in the lower San Pedro series of Deadman Island and San Pedro. Found in the Pleistocene at Pacific Beach, San Diego.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Subgenus **Vermicularia** *Lamarck.*

328. **Serpulorbis (Vermicularia)**, sp. indet.

One small nepionic shell of a species of this genus was found in the lower San Pedro series of San Pedro. Specimen identified by Dr. Dall.

Pleistocene.—San Pedro (Arnold).

Genus **Spiroglyphus** *Daudin.*

Animal forming a groove on the surface of shells or stones, covering it over with shelly matter, and forming a tubular case.

Spiroglyphus spirorbis Dillw. is a characteristic species.

329. **Spiroglyphus lituella** *Morch.*

Siphonium (*Dendropoma*) *lituella* MORCH., Proc. Zool. Soc., 1861, p. 154.

Spiroglyphus lituella MORCH., CPR., Brit. Assn. Rept., 1863, p. 654. KEEP, West Coast Shells, p. 73, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 204.

Shell small, irregularly and sometimes openly spiral, rather compressed; color dingy white; surface sculptured by incremental liruIæ and arcuate striæ, which are approximately regular; aperture circular.

Dimensions.—Diameter of coil 1.5 mm.

This little animal forms a groove on the surface of shells or stones, and covers it over with shelly matter, forming a tubular case.

Common on stones and shells of upper San Pedro series at San Pedro, Deadman Island, Crawfish George's, and Los Cerritos.

Living.—California coast (Carpenter).

Pleistocene.—San Pedro (Arnold).

Family LXXII. TURRITELLIDÆ.

Genus **Turritella** *Lamarck.*

Shell elongated; many whorled; whorls rounded, with revolving striæ; aperture rounded.

Turritella terebra Linn. is a characteristic species.

330. **Turritella cooperi** *Carpenter.*

Turritella cooperi CPR., Brit. Assn. Rept., 1863, p. 655; Proc. Cal. Acad. Sci., Vol. III, 1864, p. 216. GABB, Pal. Cal., Vol. II, p. 80, 1869. TRYON, Man. Conch., Vol. VIII, p. 20, Pl. LXI, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 269. KEEP, West Coast Shells, p. 73, fig. 58, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 318. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205.

This species is distinguishable from *T. jewettii* by its deeply impressed and distinct suture, faint spiral ridges (lacking entirely in some specimens), circular aperture, and sharper spire, the deflection in this species being only 10 degrees. Resembles Atlantic form, *T. apicalis.*

Rather common in the Pliocene and Pleistocene of San Pedro and vicinity. Found in the Pliocene at Pacific Beach and Russ School, San Diego; and in the Pleistocene at Pacific Beach, San Diego; and at Barlow's ranch and the irrigating ditch, Ventura.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego; Ventura (Arnold).

Pliocene.—San Diego well (Dall): San Pedro; San Diego (Arnold): San Quentin Bay, Lower California (Orcutt).

331. **Turritella jewettii** *Carpenter.*

PLATE IV, FIG. 13.

Turritella jewettii CPR., Brit. Assn. Rept., 1863, p. 655; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XVII, 1866, p. 276. GABB, Pal. Cal., Vol. II, p. 80, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 269.

? *Turritella sanguinea* REEVE, COOPER (WILLIAMSON), Bull. No. 4, Cal. St. Min. Bureau, 1894, Part 3, p. 32.

Shell turreted, with slender, tapering spire; number of whorls variable; whorls flat, with two distinct spiral ridges on anterior portion and three or four less distinct ridges posteriorly; incremental lines distinct and concave anteriorly; suture thread-like and rather indistinct, not usually impressed; aperture angular.

Dimensions.—Defl. 16 degrees.

The spiral sculpture in this species is quite variable, the prominence of the various ridges not being constant; the suture is also somewhat impressed in some specimens. A more solid shell than *T. cooperi*, being less slender, having more prominent spiral sculpture, a more angular aperture and a less distinct suture than the latter species. The shell listed by Mrs. Williamson as *T. sanguinea* from the San Pedro Pleistocene is probably this species, as Carpenter in his original description (the type being a Pleistocene fossil from Santa Barbara) says that *T. jewettii* is near *T. sanguinea.*

Common in the Pliocene, rarer in the lower San Pedro series, and still rarer in the upper San Pedro series of San Pedro and vicinity. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—San Diego well (Dall): San Pedro (Arnold).

Family LXXIII. LITTORINIDÆ.

Genus **Littorina** *Ferussac.*

Shell turbinated, thick, pointed, few-whorled; aperture rounded; outer lip acute; columella rather flattened, imperforate.

Littorina litorea Linn. is a characteristic species.

332. **Littorina planaxis** (*Nuttall*) *Philippi.*

Littorina planaxis NUTT., PHILIPPI, *teste* CPR., Proc. Zool. Soc., 1856, p. 266. CPR., Brit. Assn. Rept., 1863, p. 655. GABB, Pal. Cal., Vol. II, p. 80, 1869. TRYON, Man. Conch., Vol. IX, p. 248, Pl. XLIII, figs. 55, 56; Pl. XLIV, fig. 57, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 246. KEEP, West Coast Shells, p. 68, fig. 53, 1892. =*L. patula* GLD. (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 321). WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205.

Shell small, broadly conical; spire not much elevated; whorls three, convex, the last being ventricose; surface roughened by lines of growth; aperture ovate; outer lip thin; inner lip and columella flattened and effuse.

Dimensions.—Alt. 8 mm.; lat. 6.2 mm.; aperture 5 mm. x 3.5 mm.; defl. 70 degrees.

Distinguishable from *L. scutulata* by lack of coloration, rough surface, very effuse inner lip, greater deflection, and fewer whorls. Specimens identified by Dr. Dall.

One specimen each, from the upper San Pedro series of San Pedro, and lower San Pedro series of Deadman Island; found also in the lower San Pedro series at San Pedro; and in the Pliocene of Deadman Island.

Living.—Sitka; San Diego (Cooper).

Pleistocene.—San Nicolas Island; San Diego (Cooper): San Pedro (Arnold).

333. Littorina scutulata *Gould.*

Littorina scutulata GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1849, p. 83; Wilkes' Expl. Exped., Vol. XII, p. 200, fig. 241, 1852. CPR., Brit. Assn. Rept., 1863, p. 656. TRYON, Man. Conch., Vol. IX, p. 250, Pl. XLV, figs. 98-103, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 246. KEEP, West Coast Shells, p. 68, fig. 52, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205.

Littorina plena GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1849, p. 84; Wilkes' Expl. Exped., Vol. XII, p. 201, fig. 236, 1852.

Shell small, conical; spire elevated, subacute; whorls four, very slightly convex, the last one ventricose and slightly angulated; sculpture consists of numerous nearly obsolete, spiral striæ, and fine, oblique, incremental lines; aperture ovate; outer lip thin, lower part effuse; inner lip incrusted, effuse; color reddish brown.

Dimensions.—Alt. 10 mm.; lat. 6 mm.; aperture 5 mm. x 3 mm.; defl. 48 degrees.

All the specimens from the Pleistocene that have been examined show a characteristic reddish brown color. Several specimens identified by Dr. Dall; among them two which were marked "variety," but which have been included in this species for lack of constant varietal differences.

Found in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at Los Cerritos, Crawfish George's, San Pedro, Long Beach, and Deadman Island. Found in the Pleistocene at Barlow's ranch, Ventura; and at Pacific Beach and Spanish Bight, San Diego.

Living.—Monterey to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

Genus **Lacuna** *Turton.*

Shell turbinated, thin; aperture semilunar; columella flattened, with an umbilical fissure.

Lacuna pallidula Da Costa is a characteristic species.

334. Lacuna compacta *Carpenter.*

Lacuna ? var. compacta CPR., Brit. Assn. Rept., 1863, p. 656.

Lacuna (? solidula, var.) *compacta* CPR., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XIV, 1864, p. 429. TRYON, Man. Conch., Vol. IX, p. 266, Pl. L, fig. 71, 1887.

Shell small, thin, compact; spire elevated, subacute; whorls four, slightly convex; body-whorl prominently angulated at base; suture impressed, distinct; aperture ovate; outer lip not effuse, thin; inner lip slightly effuse; chink very small, almost obsolete; surface faintly marked with very fine incremental lines.

Dimensions.—Long. 6 mm.; lat. 4 mm.; aperture 3 mm. x 2 mm.; defl. 60 degrees.

Distinguishable by its compactness, angulated body-whorl, small chink and angle of deflection. The specimen described was identified by Dr. Dall as probably being of this species.

Some specimens of *L. compacta* in the State Museum collection at Berkeley are labeled *L. solidula*.

Rare in lower San Pedro series at Deadman Island; and in the upper San Pedro series at Los Cerritos and San Pedro. Found in the Pleistocene at Barlow's ranch, Ventura; at bath-house, Santa Barbara; and at Spanish Bight, San Diego.

Living.—Vancouver district (Carpenter).

Pleistocene.—San Pedro; Ventura; Santa Barbara; San Diego (Arnold).

335. Lacuna porrecta *Carpenter*.

Lacuna porrecta CPR., Brit. Assn. Rept., 1863, p. 656; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XIV, 1864, p. 429. TRYON, Man. Conch., Vol. IX, p. 265, Pl. L, figs. 55, 56, 57, 1887. KEEP, West Coast Shells, p. 66, 1892.

Shell small, white; spire not much elevated; whorls three, convex; body-whorl very slightly angulated; suture distinct; aperture ovate; lip effuse; umbilical chink large.

Dimensions.—Long. 6 mm.; lat. 5 mm.; body-whorl 5.7 mm.; aperture 4.5 mm.; defl. 74 degrees.

Distinguishable by large umbilical chink, depressed spire, large angle at apex, and effuse outer lip.

Three specimens of this species found in the lower San Pedro series at Deadman Island; also found in same horizon at San Pedro; and in the upper San Pedro series at Deadman Island, San Pedro, Los Cerritos, and Crawfish George's.

Living.—Vancouver district (Carpenter).

Pleistocene.—San Pedro (Arnold).

336. Lacuna solidula (*Lovén*) *Carpenter*.

PLATE VIII, FIG. 11.

Lacuna solidula LOVÉN, Index Moll. Scandin., p. 23 (*teste* CPR., Brit. Assn. Rept., 1863, p. 656). GABB, Pal. Cal., Vol. II, p. 80, 1869. TRYON, Man. Conch., Vol. IX, p. 266, Pl. L, fig. 69, 1887. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244. KEEP, West Coast Shells, p. 66, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 321. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 205.

Lacuna carinata GLD., Proc. Bost. Soc. Nat. Hist., 1848, p. 75.

Littorina pedroana CON., Pac. R. R. Rept., Vol. V, p. 327, Pl. VI, fig. 50, 1856.

Modelia striata GABB, Proc. Phil. Acad. Nat. Sci., 1861, p. 368.

Shell small, turreted, thin; spire elevated, subacute; whorls four, rounded, ornamented with fine oblique incremental lines; suture deeply impressed, distinct; aperture large, ovate; outer lip thin; inner lip sharp, effuse, incrusted; small umbilical chink.

Dimensions.—Long. 10 mm.; lat. 6.2 mm.; body-whorl 7.5 mm.; aperture 5.5 mm.; defl. 44 degrees.

Distinguishable from other members of the genus found in this formation by its elevated spire, deeply impressed suture, and small deflection. The specimen described was identified by Dr. Dall.

Rare in lower San Pedro series at Deadman Island and upper San Pedro series at San Pedro. Found also in the Pleistocene at Pacific Beach, San Diego. The specimen figured is somewhat decorticated, came from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Alaska to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Family LXXIV. FOSSARIDÆ.

Genus **Fossarus** *Philippi.*

Shell perforated, sculptured; inner lip thin; aperture semilunate.

Fossarus costatus Brocchi is a characteristic species.

Subgenus **Isapis** *H. & A. Adams.*

Shell umbilicated; spire elevated; cancellated, or with revolving ribs; columella with a small median tooth.

Isapis anomala C. B. Adams is a characteristic species.

337. **Fossarus (Isapis) fenestrata** *Carpenter.*

Isapis fenestrata Cpr., Brit. Assn. Rept., 1863, p. 656; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 28. Keep, West Coast Shells, p. 65, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 206.

Shell small, turreted; spire elevated, subacute; whorls four, slightly convex, ornamented with prominent, squarish, raised, spiral ridges, with numerous fine, oblique liruke in the interspaces; three spiral ridges on penultimate whorl, twelve to thirteen on body-whorl; suture deeply impressed, distinct; aperture ovate; outer lip thin, slightly effuse; inner lip flattened, effuse; umbilical chink small.

Dimensions.—Long. 8 mm.; lat. 7 mm.; body-whorl 7 mm.; aperture, 5 mm.; defl. 65 degrees.

Found in the lower San Pedro series of Deadman Island and San Pedro, and in the upper San Pedro series at Crawfish George's, San Pedro, and Deadman Island.

Living.—Vancouver to San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

Family LXXV. RISSOIDÆ.

Genus **Rissoa** *Fréminville.*

Shell minute, white or horny; conical pointed, many-whorled; smooth, ribbed or cancellated; aperture rounded; peristome entire, continuous; outer lip slightly expanded, thickened.

Rissoa costulata Risso is a characteristic species.

338. **Rissoa acutelirata** *Carpenter.*

PLATE IV, FIG. 12.

Rissoa acutelirata CPR., Brit. Assn. Rept., 1863, p. 656.

Shell minute, conical, pointed, rather thick; whorls five, convex, with fifteen sharp, distant, spiral riblets, traveling over eighteen sharp distant ribs, which are obsolete on base of body-whorl; aperture ovate; peristome entire, continuous.

Dimensions.—Long. 1.5 mm.

This minute little shell is seen under the microscope to have a very cancellated sculpture. Specimens identified by Dr. Dall.

Rare in upper San Pedro series of San Pedro. Two specimens. Found also in the Pleistocene at the old irrigating ditch, Ventura. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—San Diego (Carpenter).

Pleistocene.—San Pedro; Ventura (Arnold).

Subfamily *HYDROBIINÆ.*

Genus **Paludestrina** *d'Orbigny.*

Shell conical, more or less elongated; smooth, imperforate or nearly so; apex acute; aperture ovate; peritreme continuous; outer lip acute; inner lip not thickened.

Paludestrina piscium d'Orbigny is a characteristic species.

339. **Paludestrina curta,** sp. nov.

PLATE VIII, FIG. 2.

Shell small, conical, very thin; spire elevated; apex rounded; whorls four, very convex, smooth, except for obsolete transverse sculpture; suture deeply impressed, distinct; aperture oval; peritreme continuous, thin; umbilicus subperforate.

Dimensions.—Long. 4 mm ; lat. 2.2 mm.; body-whorl 2.6 mm.; aperture 1.5 mm.; defl. 38 degrees.

Distinguishable from *P. stokesi* by much broader shell, fewer whorls, and more perforate umbilicus. Pronounced a new species by Dr. Dall.

Rare in lower and upper San Pedro series of San Pedro. The specimen figured is the type, which is from the lower San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

340. **Paludestrina stokesi,** sp. nov.

PLATE VIII, FIG. 3.

Shell small, conical, thin; spire elevated; apex acute; whorls six, very convex; surface with faint, nearly obsolete, rounded, transverse ridges; suture deeply impressed, distinct; body-whorl evenly ventricose; aperture oval; peritreme continuous; outer lip acute; inner lip not thickened; umbilicus nearly obsolete.

Dimensions.—Long. 4.8 mm.; lat. 2 mm.; body-whorl 2.5 mm.; aperture 1 mm.; defl. 22 degrees.

This little fresh-water gastropod is distinguishable by its small size, thin shell, very convex whorls and continuous peritreme. Specimens pronounced a new species by Dr. Dall. Named in honor of Mr. Frank Stokes of Pasadena, California.

Rare in upper and lower San Pedro series of San Pedro. The specimen figured is the type, which is from the lower San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

Family LXXVI. CALYPTRÆIDÆ.

Genus **Crucibulum** *Schumacher.*

Shell conical, more or less regular, with subcentral, subposterior, sharp apex; aperture basal, with a central, internal, cup-shaped lamina, which is entire, and attached along a line on one side to the inner wall of the shell.

Section *Crucibulum, s. s.*

Distinguished from *Dispotæa* by having in the adult the whole margin of the internal cup free from the shell, and the cup as a whole merely attached by a narrow strip of adhesion.

Crucibulum rudis Brod. is a characteristic species.

341. **Crucibulum spinosum** *Sowerby.*

Calyptræa spinosa SBY., Gen. of Shells, Pl. XXIII, figs. 4, 7, 1824.

Crucibulum spinosum SBY., REEVE, Icon. Conch., Sp. 10. CONRAD, Pac. R. R. Rept., Vol. V, p. 327, Pl. V, fig. 46, 1856. CPR., Brit. Assn. Rept., 1856, p. 323, Pl. IX, figs. 3*a*, 3*p*; *id.*, 1863, p. 654. GABB, Pal. Cal., Vol. II, p. 81, 1869; Geol. San Domingo, p. 241, 1873. TRYON, Man. Conch., Vol. VIII, p. 118, Pl. XXXII, fig. 38, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 237. KEEP, West Coast Shells, p. 77, fig. 62, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 203.

Crucibulum auricula var. *spinosum* SBY., =*Dispotæa dumosa* CON. (young shell), =*Crucibulum dumosum* TUOMEY & HOLMES (young shell), (*fide* DALL, Trans. Wagner Inst. Sci., Vol. III, Part 3, 1892, p. 350.)

Shell conical, elevated; apex rather acute, slightly curved, smooth, subcentral; surface ornamented with numerous rounded, radiating ridges, and sometimes with concentric rows of spires; concentric lines of growth visible; a cup-shaped lamina is attached along a line on one side of the interior of the shell; inner surface smooth; rim thin; aperture nearly circular.

Dimensions.—Diam. 21 mm.; alt. 13.5 mm.

The only member of this genus found in the San Pedro series of this locality. Dr. Dall says that the recent specimens from California agree in the minutest particular with the Caloosahatchie fossils. This is probably a case of a survival of an old form.

Common in the lower San Pedro series of Deadman Island, and in upper San Pedro series of Deadman Island, San Pedro, Los Cerritos, Long Beach, and Crawfish George's. Found in the Pleistocene at Twenty-sixth Street and Pacific Beach, San Diego.

Living.—Monterey to San Diego (Carpenter): south to Peru (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Diego well (Dall): Caloosahatchie beds and Alligator Creek, Florida (Dall and Willcox).

Miocene.—(Newer) North and South Carolina (Conrad and Holmes): (older) San Domingo (Gabb).

Genus **Galerus** *Humphrey.*

Shell depressed, subconical, spiral; summit subcentral; aperture very large, basal, with a subspiral broad lamina adhering to the left margin.

Galerus chinensis Linn. is a characteristic species.

342. **Galerus mammillaris** *Broderip.*

Galerus mammillaris Brod., Trans. Zool. Soc., 1835, Pl. XXIII, fig. 5. Cpr., Brit. Assn. Rept., 1856, p. 323. =*Calyptrea fastigiata* Gld., =(?) *Galerus contortus* Cpr. (*fide* Dall, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 203).

Calyptrea mammillaris Brod., Tryon, Man. Conch., Vol. VIII, p. 120, Pl. XXXIV, figs. 64–75, 78–81, 1886.

Shell depressed, subconical; whorls flattened, three; apex central, blunt; aperture subcircular, large; a broad lamina begins at apex on inner surface and makes a whole turn to the left, reaching nearly to margin; lower part of body-whorl corrugated; surface marked by irregular spiral striæ.

Dimensions.—Long. 32 mm.; lat. 30 mm.; alt. 7 mm.

The specimen described was identified by Dr. Dall.

Rare in lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series at Crawfish George's and San Pedro.

Living.—Puget Sound to Monterey (Cooper): Santa Barbara to Central America (Carpenter): San Pedro (Williamson).

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Diego well (Dall).

Genus **Crepidula** *Lamarck.*

Shell oval, limpet-like, with a posterior, generally lateral spiral apex; interior with a shelly lamina covering its posterior half.

Crepidula peruviana Lam. is a characteristic species.

343. Crepidula aculeata *Gmelin.*

Patella aculeata GMEL., Syst. Nat., p. 3693, 1788.

Crepidula aculeata GMEL., =*Calyptræa echinus* BROD., =*Calyptræa hystrix* BROD., =*Crepidula californica* NUTT. (*fide* CPR., Brit. Assn. Rept., 1856, p. 323, Pl. VIII, figs. 3*a*, 3*j*). CPR., Brit. Assn. Rept., 1863, p. 654. TRYON, Man. Conch., Vol. VIII, p. 129, Pl. XXXIX, figs. 61-65, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 236. DALL, Bull. U. S. Nat. Mus., No. 37, 1889, p. 152. KEEP, West Coast Shells, p. 76, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 357. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 203.

Shell small, deep, thin; apex near anterior margin curved to left, smooth; surface sculptured with numerous prominent rounded, discontinuous, irregular ridges from near apex to margin; margin thin, crenulated; aperture subquadrate; deck oblique, thin, cupped, lower on right side than on left; inner surface smooth.

Dimensions.—Long. 11 mm.; lat. 9 mm.; alt. 6 mm.

The specimen described was identified by Dr. Dall. The occurrence of this species on both sides of the American continent is probably due to the survival of an old form which has changed little since the two regions were closely connected by water.

Rare in the lower San Pedro series of San Pedro and Deadman Island.

Living.—Monterey, south; Asia; Atlantic (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—San Fernando (Cooper): De Leon Springs, Shell Creek, and Alligator Creek, Florida (Dall and Willcox).

344. Crepidula adunca *Sowerby.*

Crepidula adunca SBY., Tank. Cat., Appen., p. 7, 1825. CPR., Brit. Assn. Rept., 1863, p. 654. GABB, Pal. Cal., Vol. II, p. 82, 1869. TRYON, Man. Conch., Vol. VIII, p. 129, Pl. XXXVIII, figs. 51-55; Pl. XXXVII, figs. 39, 40; Pl. XXXIX, fig. 60, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 236. KEEP, West Coast Shells, p. 75, fig. 60, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, pp. 355, 358. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 203.

Crepidula rostriformis GLD., Proc. Bost. Soc. Nat. Hist., Vol. II, 1846, p. 160; Wilkes' Expl. Exped., Vol. XII, p. 375, fig. 482, 1852.

Crypta adunca SBY., H. & A. ADAMS, Gen. Rec. Moll., Vol. I, p. 369, 1853.

Shell nearly circular at base, elevated and curved backwards to apex; apex elevated, sharp, hooked, and removed from margin; surface marked with fine lamellar lines of growth; aperture nearly circular; margin thin; deck short, thin in middle, thicker towards sides, with anterior edge deeply curved; cavity penetrates beak from deck; deck set deep in shell.

Dimensions.—Long. 19 mm.; lat. 12.5 mm.; alt. 10.5 mm.; aperture 15 mm. x 12.5 mm.

This shell is easily distinguishable by its elevated apex and short, curved-edged deck. Dr. Dall identified the shell described. This is the West Coast form of the Atlantic *C. convexa* Sby.

Rather rare in the lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of Los Cerritos, Crawfish George's, San Pedro, and

Deadman Island. Found in the Pleistocene at the bath-house, Santa Barbara; at Barlow's ranch, Ventura; and at Spanish Bight, San Diego.

Living.—Straits of Fuca to Santa Barbara; Mexico (Cooper).

Pleistocene.—Santa Barbara; San Diego (Cooper): San Pedro; Santa Barbara; Ventura; San Diego (Arnold).

345. Crepidula dorsata *Broderip.*

Crepidula dorsata BROD., Proc. Zool. Soc., 1834, p. 38. CPR., Brit. Assn. Rept., 1863, p. 654. GABB, Pal. Cal., Vol. II, p. 82, 1869. TRYON, Man. Conch., Vol. VIII, p. 127, Pl. XXXVII, figs. 26–30; Pl. XXXVIII, fig. 41, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 236. KEEP, West Coast Shells, p. 76, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part IV, 1892, p. 358.

Crypta dorsata BROD., H. & A. ADAMS, Gen. Rec. Moll., Vol. I, p. 369, 1853.

Shell small, much depressed; apex curved to one side and upward, smooth on tip; surface sculptured with rough, rounded, radiating ridges, expanding and also increasing in number by intercallation toward the margin; aperture round; margin crenulated and thickened; deck partly detached, thin, oblique, with pit at apex.

Dimensions.—Diam. 10 mm.; alt. 3 mm.

Rare in the lower San Pedro series of Deadman Island; and upper San Pedro series of Crawfish George's and Los Cerritos.

Living.—Straits of Fuca to Mazatlan; Peru, South America (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Pliocene.—San Fernando (Cooper).

346. Crepidula grandis *Middendorff.*

Crepidula grandis MIDD., Mal. Ross., Part II, p. 101, Pl. XI, figs. 8, 9, 10, 1849. CPR., Brit. Assn. Rept., 1863, p. 584. GABB, Pal. Cal., Vol. II, p. 81. 1869. TRYON, Man. Conch., Vol. VIII, p. 127, Pl. XXXVII, fig. 33, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 237. DALL, Trans. Wagner Inst. Sci., Vol. III, Part II, 1892, p. 358.

Shell heavy, elevated obliquely from an oval base; sides flattened; apex narrowed, curving nearly to side margin; surface sculptured by numerous fine lamellar lines of growth; deck long, thick (much thicker on side opposite from apex) and showing lines of growth on inner side, occupies over half of aperture, joins shell near margin.

Dimensions.—Long. 80 mm.; lat. 50 mm.; alt. 45 mm.; aperture 60 mm.

The rim, especially near the posterior end, shows the lamellar structure of the shells. These shells have a very pronounced habit of growing one upon another until the group sometimes numbers six or eight individuals. This species is easily recognized by its size and thickness.

Dr. Dall unites *C. prærupta* Con. and *C. princeps* Con., but separates this species from *C. grandis* Midd. It has been the writer's privilege to examine quite a series of *C. prærupta* Con. from the Astoria Miocene of Blakeley, Washington, and it is his opinion, also, that this species is distinct from *C. grandis*. Two specimens in the upper San Pedro series of Deadman Island. Found also in the Pliocene at Pacific Beach, San Diego.

Living.—Kamtschatka; Hakodate, Japan; Okhotsk (Carpenter).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

Pliocene.—Santa Rosa; Kirker's Pass; Santa Barbara; San Fernando; San Diego well (Cooper): Alpine Creek, San Mateo County; Stanford University; San Diego (Arnold).

Miocene.—Tomales, Marin County; Walnut Creek, Contra Costa County; Foxin's and Santa Rosa Island, Santa Barbara County (Cooper).

347. **Crepidula navicelloides** *Nuttall.*

Crepidula navicelloides NUTT., Jay's Cat., No. 3035, 1835. CPR., Brit. Assn. Rept., 1863, p. 654. GABB, Pal. Cal., Vol. II, p. 82, 1869. TRYON, Man. Conch., Vol. VIII, p. 126, 1886. COOPER, 7th Ann. Rept., Cal. St. Min., 1888, p. 237. KEEP, West Coast Shells, p. 76, fig. 61, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 203.

Crepidula nummaria GLD., Proc. Bost. Soc. Nat. Hist., Vol. II, 1846, p. 60; Wilkes' Expl. Exped., Vol. XII, p. 377, fig. 480, 1852.

Crepidula explanata GLD., Mex. and Cal. Shells, p. 4, Pl. XIV, fig. 7, 1853; Proc. Zool. Soc., 1856, p. 205.

This shell varies greatly in shape, due to the surface on which it grows. Specimens showing an easy gradation from the circular, flat variety, *C. nummaria*, through the typical, oblong, flat, *C. navicelloides*, to the elongated, curved variety, *C. explanata*, have been found in the upper San Pedro series of San Pedro. This species may be distinguished from the other members of this genus by its flat or dorsally concave appearance, and by the way in which the deck is raised in the center to allow body space between it and the inner surface of the shell. Representatives of the above forms were identified by Dr. Dall as this species.

Rare in the lower San Pedro series of Deadman Island; and in the upper San Pedro series of Crawfish George's, Los Cerritos, San Pedro, and Deadman Island. Found also in the Pleistocene at the bath-house, Santa Barbara.

Living.—Alaska to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara (Arnold).

Pliocene.—San Diego well (Dall).

348. **Crepidula onyx** *Sowerby.*

Crepidula onyx SBY., Genera of Shells, No. 23, fig. 2, 1824. CPR., Proc. Zool. Soc., 1856, p. 225; Brit. Assn. Rept., 1856, p. 323. TRYON, Man. Conch., Vol. VIII, Pl. XXXVII, fig. 37; Pl. XXXVIII, figs. 43–50; Pl. XXXIX, fig. 59, 1886.

Shell ovate, generally irregular, low arched, strong; apex small, marginal, sharp and turned to one side; surface marked by concentric lamellar lines of growth; aperture irregularly ovate; rim thin; interior reddish brown (shows in all Pleistocene specimens examined), except for border equal in width to the space between the deck and the rim, which is light colored; deck thin, with nearly straight edge; slight depression where deck joins shell on right side; deck curves upward at margin where it joins shell, making the line of contact indistinct in most specimens, the deck merging into the shell.

Dimensions.—Long. 32 mm.; lat. 25 mm.; alt. 10 mm.

This shell may be distinguished from *C. rugosa* by its larger size, depressed form, interior coloration, and by the indistinctness of the line of contact between the deck and the shell. The deck of *C. onyx* is also joined to the shell nearer the rim than is the deck of either *C. rugosa* or *C. adunca.*

This specimen was identified by Dr. Dall.

Rare in the lower San Pedro series of Deadman Island and San Pedro; and in upper San Pedro series of Deadman Island, Los Cerritos, and San Pedro. Found also in the Pleistocene at Spanish Bight and Pacific Beach, San Diego.

Living.—Panama, Central America (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

349. Crepidula rugosa *Nuttall.*

Crepidula rugosa NUTT., mss., Proc. Zool. Soc., 1856, p. 224. CPR., Brit. Assn. Rept., 1863, p. 654 TRYON, Man. Conch., Vol. VIII, p. 128, Pl. XXXVII, fig. 37, 1886. KEEP, West Coast Shells, p. 76, 1892.

Crepidula onyx SBY. var. *rugosa* NUTT., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 203.

Shape of shell similar to *C. onyx*, but more arched; apex prominent, submarginal, sharp, hooked, smooth, turned only slightly to one side; lines of growth irregular; surface rugose, and quite glossy in some specimens; aperture oval; margin thin; deck deeply sunken in shell, and line of contact with shell very distinct; edge of deck straight.

Dimensions.—Long. 20 mm.; lat. 12 mm.; alt. 10 mm.; aperture 15.5 mm. x 12 mm.

Distinguishable from *C. onyx* by more prominent apex, which is further from the margin than in the latter; by the deeper set deck and by the less prominent lines of growth. Smaller than *C. onyx*. This specimen was identified by Dr. Dall.

Found in lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of Crawfish George's, Deadman Island, San Pedro, Los Cerritos, and Long Beach.

Living.—Santa Barbara to San Diego (Cooper): Mexico to Peru ? (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

Family LXXVII. AMALTHEIDÆ.

Genus **Hipponyx** *De France.*

Shell thick, obliquely conical, non-spiral; apex somewhat posterior and curved backwards; muscular impression horseshoe-shaped; base of attachment shelly, secreted by the foot of the animal.

Hipponyx cornucopiæ Lam. is a characteristic species.

350. Hipponyx antiquatus *Linnæus*.

Patella antiquatus LINN., Syst. Nat., Ed. XII, p. 1259, 1768. DILLW., p. 1035, No. 44, 1760.
Hipponyx antiquatus LINN., MENKE, Zeit. f. Mal., p. 79, 1853. CPR., Proc. Zool. Soc., 1856, p. 3; Brit. Assn. Rept., 1863, p. 654. TRYON, Man. Conch., Vol. VIII, p. 134, Pl. XL, figs. 93–99, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244. KEEP, West Coast Shells, p. 74, fig. 59, 1892.
Concholepas antiquatus LINN., H. & A. ADAMS, Gen. Rec. Moll., Vol. I, p. 373, 1853.

Shell obliquely conical; apex blunt, projecting beyond posterior margin of shell; surface roughened by prominent lamellar, concentric lines of growth; base ovate; rim smooth, not crenated.

This is a very variable species, the specimen described having an unusually elevated apex. The specimen was identified by Dr. Dall.

Carpenter believes the *Hipponyx mitrula* of the West Indian fauna to be identical with the *Hipponyx antiquatus* of the Pacific Panama region. If these two are identical it is another case of an old species which has lived on in both habitats, having changed but little since the two regions were connected by water; or else it is a case of parallel development, where two species, having come from a common stock and living among like conditions, though separated geographically, have developed along parallel lines and are enough alike at the present time to warrant their being called the same species. In such a genus as *Hipponyx*, where there are so many mutations in a single species, either case would be possible.

One specimen from the lower San Pedro series of Deadman Island; also found in the Pliocene of Deadman Island.

Living.—Bodega Bay and south; South America; Atlantic (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold).

351. Hipponyx cranioides *Carpenter*.

Hipponyx cranioides CPR., Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XIII, 1863, p. 428. TRYON, Man. Conch., Vol. VIII, p. 135, Pl. XL, figs. 6, 7, 1886. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 244.

Shell obliquely conical, depressed; apex inconspicuous, blunt, posterior to center, but not reaching margin; surface ornamented with several wide lamellæ of growth which are grooved by numerous radiating furrows; aperture ovate; rim thin, sometimes corrugated near outer edge; interior smooth.

Dimensions.—Long. 19 mm.; lat. 17 mm.; alt. 6 mm.

Distinguishable from *H. antiquatus* by depressed shell, more central apex, and more regular lamellæ of growth, which are prominently radially furrowed. The specimen described was identified by Dr. Dall.

According to Tryon *H. tumens* equals *H. cranioides*.

Rather common in the lower San Pedro series at Deadman Island and San Pedro; rare in upper San Pedro series at Deadman Island and Los Cerritos. Found also in the Pleistocene at Spanish Bight, San Diego.

Living.—Straits of Fuca to Santa Barbara (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego (Arnold).

352. Hipponyx tumens *Carpenter*.

Hipponyx tumens Cpr., Brit. Assn. Rept., 1863, p. 654; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XV, 1865, p. 181.
Capulus tumens Cpr., Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 232.

Shell of medium size, tumid, with oval base; apex distinct, small, sharp, curved to right side, raised above margin; surface sculptured by numerous sharp, distinct, raised radiating lines and less prominent lines of growth, which give the radiating lines a slightly granulose appearance; aperture oval, slightly effuse, and finely crenulated on outer border.

Dimensions.—Long. (including apex) 11.5 mm.; lat. 10 mm.; alt. 5 mm.

Distinguishable from *H. antiquatus* by its rather faint, regular sculpture, of which the radiating lines are much more prominent than the concentric.

One specimen from the lower San Pedro series of Deadman Island; also found in lower San Pedro series at San Pedro; and in the upper San Pedro series at Deadman Island. Found also in the Pleistocene at Pacific Beach, San Diego.

Living.—Monterey to San Diego and Islands (Cooper).

Pleistocene.—San Pedro (Cooper; Arnold): San Diego (Arnold).

Family LXXVIII. NATICIDÆ.

Genus **Natica** (*Adanson*) *Scopoli*.

Shell subglobular; spire slightly elevated; aperture half round; a spiral columellar callus entering the umbilicus.

Natica canrena Linn. is a characteristic species.

Subgenus **Cryptonatica** *Dall*.

Naticas with smooth calcareous operculum and an umbilicus entirely and smoothly filled with callus.

Type, *Natica clausa* Brod. & Sowb.

353. Natica (Cryptonatica) clausa *Broderip & Sowerby*.

Plate X, Fig. 13.

Natica clausa Brod. & Sby., Zool. Jour., Vol. IV, 1829, p. 360; Zool. Beechey's Voyage, p. 136, Pl. XXXIV, fig. 3; Pl. XXXVII, fig. 6, 1839. Cpr., Brit. Assn. Rept., 1863, p. 661. Gabb, Pal. Cal., Vol. II, p. 77, 1869. Tryon, Man. Conch., Vol. VIII, p. 30, Pl. IX, figs. 65, 67–69, 73, 1886. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 253. Keep, West Coast Shells, p. 46, 1892.
Natica russa Gld., Proc. Bost. Soc. Nat. Hist., Vol. VII, 1859, p. 43; Otia, p. 109, 1862. Cpr., Brit. Assn. Rept., 1863, p. 586. Cooper, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 29.

Shell of medium size, ovate-globular; spire only slightly elevated; whorls four, evenly convex, though sometimes slightly shouldered; surface smooth except for fine incremental lines;

suture impressed, distinct; aperture semilunar; outer lip sharp; inner lip callous and reflected completely over the umbilicus.

Dimensions.—Alt. 27 mm.; lat. 25 mm.; aperture 20 mm. x 12.5 mm.; defl. 115 degrees.

After comparing a series of *Naticas* collected from the Pliocene of Deadman Island, part of which were identified as *N. russa* and part as *N. clausa* by Dr. Dall, it is very evident that there is no difference between the two species. This species is distinguishable from *Neverita recluziana* by a more elevated spire, more evenly convex whorls, and a more concave umbilical region.

Rare in Pliocene of Deadman Island and Timm's Point. None have been found in the Pleistocene by the writer, except one small specimen which came from the lower San Pedro series at Deadman Island. Found in the Pliocene at Packard's Hill, and in the Pleistocene at the bath-house, Santa Barbara. The specimen figured is a medium sized one from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—Arctic Ocean; Alaska; North Atlantic (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara (Arnold).

Pliocene.—San Pedro; Santa Barbara (Arnold).

Genus **Polynices** *Montfort.*

This group includes all of the Naticidæ with corneous opercula.

Type, *Natica mammilla* Linn.

Subgenus **Neverita** *Risso.*

Shell depressed, orbicular; spire conical or flattened; columella partly filled by a tongue-shaped callous process (funiculum) from the columella. Operculum horny.

Natica duplicata Say is a characteristic species.

354. **Polynices (Neverita) recluziana** *Petit.*

PLATE X, FIG. 12.

Natica recluziana PETIT, DESHAYES, Mag. de Zool., Mollusca, p. 37, 1841. TRYON, Man. Conch., Vol. VIII, p. 34, Pl. XII, fig. 1, 1886.

Neverita recluziana PETIT, H. & A. ADAMS, Gen. Rec. Moll., Vol. I, p. 208, 1853. CPR., Brit. Assn. Rept., 1863, p. 661. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 254. KEEP, West Coast Shells, p. 46, fig. 26, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 211.

Neverita recluziana DESH., GABB, Pal. Cal., Vol. II, p. 77, 1869. DALL, Trans. Wagner Inst. Sci., Vol. III, Part 2, 1892, p. 369.

Shell ovate to flattened globular; spire only very slightly elevated, obtuse; whorls three, slightly convex; body-whorl having a long, slightly convex slope from suture to near base, where it suddenly turns under to umbilicus; surface ornamented with fine, oblique incremental lines; suture distinct, but not impressed; aperture semilunar; lip thin; columella incrusted, the incrustation extending down and completely covering the umbilicus.

Dimensions.—Long. 20 mm.; lat. 24 mm.; aperture 16 mm. x 10 mm.; defl. 130 degrees. (A rather small specimen.)

The young shells are more depressed than the adults, some of them being quite flat. In some of the specimens the callus has not completely covered the umbilicus, leaving a little pit near the lower part of the umbilical region. This species is very variable in both size and shape. Dr. Dall has described a variety with an elevated spire which he calls var. *alta*. This variety is quite common in all of the upper San Pedro series localities.

Common in the upper San Pedro series of the San Pedro region, but rare in the lower San Pedro series and Pliocene. Found in the Pleistocene at Barlow's ranch and old irrigating ditch, Ventura; at Spanish Bight, Twenty-sixth Street, and Pacific Beach, San Diego; and in the Pliocene at Pacific Beach, San Diego. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Monterey to Lower California (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Santa Barbara; San Diego (Arnold).

Pliocene.—Santa Barbara; San Fernando (Cooper): San Pedro; San Diego (Arnold): San Diego well (Dall).

Miocene.—Martinez; Walnut Creek; Santa Inez; Santa Monica; Death Valley (Cooper).

Subgenus **Lunatia** *Gray*.

Shell usually somber colored; covered with a dark, thin epidermis; not so thick as the typical group; umbilicus open, without funiculum. Operculum corneous.

Type, *Natica ampullaria* Lam.

355. **Polynices (Lunatia) lewisii** *Gould*.

PLATE X, FIG. 14.

Natica lewisii GLD., Proc. Bost. Soc. Nat. Hist., 1847, p. 239; Wilkes' Expl. Exped., p. 211, Pl. XV, p. 253, 1852.

Lunatia lewisii GLD., CPR., Brit. Assn. Rept., 1863, p. 661. GABB, Pal. Cal., Vol. II, p. 77, 1869. = *N. reiniana* DUNKER (young), = *N. algida* GLD. (*fide* TRYON, Man. Conch., Vol. VIII, p. 35, Pl. XIII, figs. 11, 12; Pl. IX, fig. 70, 1886). COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 247. KEEP, West Coast Shells, p. 45, fig. 25, 1892. DALL, Trans. Wagner Inst. Sci., Vol. III, Part II, 1892, p. 374.

Natica (Lunatia) lewisii GLD., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 211.

The adult may be distinguished from *Neverita recluziana* by its large size, open umbilicus, generally more elevated spire, and a shallow, spiral groove near the anterior portion of the body-whorl. The upper whorls are more convex and more distinctly separated from each other by the suture than are the upper whorls of the latter species. All the specimens found were larger than the average *N. recluziana*, some of them being over 100 mm. in altitude.

Rare in the upper San Pedro series of San Pedro, Los Cerritos, Long Beach, Crawfish George's, and Deadman Island. The specimen figured is from the upper San Pedro series at San Pedro, and is now in the collection of Delos Arnold.

Living.—Straits of Fuca to San Diego (Cooper): Japan (Tryon): Catalina Island (Arnold).

Pleistocene.—Santa Barbara; San Nicolas Island (Cooper): San Pedro (Arnold).

Pliocene.—Kirker's Pass; Santa Barbara; San Fernando (Cooper): Soquel, Santa Cruz County (Arnold).

Genus **Sigaretus** *Lamarck.*

Shell ear-shaped, with minute spire and very large aperture; externally with revolving striæ; color usually white, with sometimes a thin, corneous epidermis. Operculum minute, horny, subspiral.

Sigaretus neritoideus Linn. is a characteristic species.

356. **Sigaretus debilis** *Gould.*

Sigaretus debilis Gld., Jour. Bost. Soc. Nat. Hist., Vol. VI, 1853, p. 379, Pl. XIV, fig. 17. Cpr., Proc. Zool. Soc., 1856, p. 207. Tryon, Man. Conch., Vol. VIII, p. 57, Pl. XXIV, fig. 65, 1886. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 264. Keep, West Coast Shells, p. 47, 1892.

"Shell small, much depressed, thin, almost pellucid; whorls two, spire almost coincident with the general surface; apex at one-fourth the diameter of the shell; periphery obtuse-angular, becoming more so as it approaches the aperture; ventral surface excavated at the umbilical region, with a slight unappressed lamina at that point; margin of the aperture having a very slight advance in the outline, as it approaches the peripheral angle; surface with very numerous and very delicate obtusely excavated revolving striæ, much finer on the ventral than on the dorsal surface."

Dimensions.—Length about 22 mm.

The above is Gould's original description.

Rare in the upper San Pedro series; one imperfect specimen from that horizon at Los Cerritos, and one nearly perfect one from the lumber yard, San Pedro.

Living.—Monterey to Lower California (Cooper).

Pleistocene.—San Pedro (Arnold).

Pliocene.—San Diego well (Cooper).

Family LXXIX. LAMELLARIIDÆ.

Genus **Lamellaria** *Montagu.*

Shell ear-shaped; thin, pellucid, fragile; spire very small; aperture large, patulous; inner lip receding.

Lamellaria perspicua is a characteristic species.

357. **Lamellaria stearnsii** *Dall.*

Lamellaria stearnsii Dall, Am. Jour. Conch., Vol. VII, 1872, p. 122, Pl. XV, fig. 6. Tryon, Man. Conch., Vol. VIII, p. 63, Pl. XXVII, figs. 12 and 13, 1886. Keep, West Coast Shells, p. 47, fig. 27, 1892. Dall, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 211.
Lamellaria depressa Dall, mss., 1866 (*fide* Dall).

Shell suborbicular, depressed; spire hardly elevated above last whorl; whorls three, convex; columella sharp, thin, widely arcuate, loosely twisted, so that the apex is discernible from below; suture distinct; aperture very effuse, rounded; marked by lines of growth, crossed by microscopic fine revolving striæ.

Dimensions.—Long. 15.2 mm.; lat. 11 mm.; alt. 7 mm.

Somewhat resembles *Sigaretus debilis*, but smaller, smoother, and more inflated.

Rare in lower San Pedro series of Deadman Island; one specimen. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—Monterey (Dall): San Pedro (Williamson): West Coast (Keep).

Pleistocene.—San Pedro; San Diego (Arnold).

Superfamily DOCOGLOSSA.

Family LXXX. ACMÆIDÆ.

Genus **Acmæa** *Eschscholtz.*

Shell solid, patuliform; apex erect or anteriorly inclined.

Acmæa mitra Esch. is a characteristic species.

358. **Acmæa depicta** *Hinds.*

Patelloida depicta Hds., Ann. Nat. Hist., Vol. X, 1842, p. 82; Voyage Sulphur, p. 53, No. 217, 1844.
Nacella depicta Hds., Proc. Zool. Soc., 1856, p. 204. Cpr., Brit. Assn. Rept., 1863, p. 650. Keep, West Coast Shells, p. 103, 1892.

Shell small, conical, with elongate-elliptical base; apex inconspicuous, about one-fifth length from posterior extremity; surface ornamented by radiating narrow bands of color.

Dimensions.—Long. 7 mm.; lat. 2.8 mm.; alt. 1.8 mm.

This species is close to *A. paleacea*, but is slightly broader, more depressed, and has bands of brown radiating from the apex.

One specimen from the upper San Pedro series at Crawfish George's.

Living.—San Diego (Carpenter).

Pleistocene.—San Pedro (Arnold).

359. Acmæa insessa *Hinds.*

Patella insessa HDS., Ann. & Mag. Nat. Hist., Vol. X, 1860, p. 82, Pl. VI, fig. 3.

Nacella incessa HDS., CPR., Brit. Assn. Rept., 1863, p. 650. GABB, Pal. Cal., Vol. II, p. 87, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 227. KEEP, West Coast Shells, p. 103, fig. 91, 1892.

Acmæa insessa HDS., DALL, Am. Jour. Conch., Vol. VI, 1871, p. 244, Pl. XIV, fig. 3. TRYON, Man. Conch., Vol. XIII, p. 18, Pl. VI, figs. 36, 37, 1891. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 197.

Shell limpet-shaped, rather thick, brown; apex acute and dark, with light band around dark spot (this coloration due to the wearing of shell through outer layer); sculpture consists of fine incremental striæ; margin inclined to be compressed as the shell grows old; apex slightly anterior.

Dimensions.—Long. 17 mm.; lat. 10 mm.; alt. 11 mm.

Found in the Pliocene of Deadman Island; the lower San Pedro series of Deadman Island and San Pedro; and the upper San Pedro series of Deadman Island, San Pedro, Los Cerritos, and Crawfish George's. Found in the Pleistocene at bath-house, Santa Barbara; and at Spanish Bight, San Diego.

Living.—Sitka to San Diego (Dall).

Pleistocene.—San Diego (Cooper): San Pedro; Santa Barbara; San Diego (Arnold).

Pliocene.—San Pedro (Arnold).

360. Acmæa instabilis *Gould.*

Patella instabilis GLD., Proc. Bost. Soc. Nat. Hist., Vol. II, 1846, p. 150.

Nacella instabilis GLD., CPR., Brit. Assn. Rept., 1863, p. 650. KEEP, West Coast Shells, p. 103, 1892.

Acmæa instabilis GLD., DALL, Am. Jour. Conch., Vol. VI, 1871, p. 245. TRYON, Man. Conch., Vol. XIII, p. 18, Pl. VI, figs. 32, 33, 1891. COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part III, 1894, p. 24.

Shell resembles *A. insessa*, but is much larger when adult; apex rounded; sculpture consists of concentric grooves and striæ.

Dimensions.—Long. 26.5 mm.; lat. 15 mm.; alt. 12 mm.

Distinguishable from *A. insessa* by its rounded apex, shallowness, and larger size. One specimen from upper San Pedro series of Crawfish George's.

Living.—Sitka to Monterey (Dall).

Pleistocene. San Pedro (Arnold): San Nicolas Island (Bowers).

361. Acmæa mitra *Eschscholtz.*

Acmæa mitra ESCH., Zool. Atlas, Vol. V, p. 18, No. 1, Pl. XXIII, fig. 4, 1833. DALL, Am. Jour. Conch., Vol. VI, 1871, p. 241, Pl. XIV, fig. 1. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 228. TRYON, Man. Conch., Vol. XIII, p. 24, Pl. III, fig. 50, 1891. KEEP, West Coast Shells, p. 99, fig. 85, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 197.

Scurria mitra ESCH., CPR., Brit. Assn. Rept., 1863, p. 650. GABB, Pal. Cal., Vol. II, p. 87, 1869.

Shell conical, apex erect, nearly central, rather sharp, smooth; posterior surface straight; anterior slightly convex; ornamentation of fine incremental lines, giving quite a rough surface to some specimens; aperture oval to nearly circular; rim smooth.

Dimensions.—Long. 31 mm.; lat. 27.5 mm.; alt. 19 mm.

Easily distinguishable by its elevated, nearly central apex, comparatively smooth, light colored surface, and its size.

Not uncommon in the upper San Pedro series of Crawfish George's.

Living.—Sitka to San Diego (Cooper): Half Moon Bay, San Mateo County (Arnold).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro (Arnold).

362. Acmæa paleacea *Gould.*

Acmæa paleacea GLD., Bost. Jour. Nat. Hist., Vol. VI, 1853, p. 376, Pl. XIV, fig. 5; Mex. and Cal. Shells, p. 3, Pl. XIV, fig. 5, 1853. DALL, Am. Jour. Conch., Vol. VI, 1871, p. 253. TRYON, Man. Conch., Vol. XIII, p. 20, Pl. VI, fig. 42, 1891. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 197.

Nacella paleacea GLD., CPR., Brit. Assn. Rept., 1863, p. 650. KEEP, West Coast Shells, p. 104, 1892.

"Shell minute, delicate, thin, elongated, laterally compressed, so that the two sides are parallel; dorsal aspect a long, narrow oval; lateral aspect low, triangular; apex at about the anterior third, acute, antrorse; surface with delicate lines of growth and a few obtuse radiating ridges along the dorsal slope at each end; color cinnamon brown."

Dimensions.—Long. 7 mm.; lat. 1.5 mm.; alt. 2 mm.

This shell has little resemblance to any of the others of its genus found in this formation, and may readily be distinguished by its small size and peculiar shape. Dr. Dall identified the specimen.

Rare in the upper San Pedro series of Crawfish George's; two specimens found.

Living.—Santa Barbara (Jewett): Monterey; San Diego (Dall).

Pleistocene.—San Pedro (Arnold).

363. Acmæa pelta *Eschscholtz.*

Acmæa pelta ESCH., Zool. Atl., Vol. V, p. 19, No. 5, 1833. CPR., Brit. Assn. Rept., 1863, p. 650. GABB, Pal. Cal., Vol. II, p. 52, 1869. DALL, Am. Jour. Conch., Vol. VI, 1871, p. 246, Pl. XIV, fig. 6. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 228. TRYON, Man. Conch., Vol. XIII, p. 17, Pl. VIII, figs. 86–95, 1891. KEEP, West Coast Shells, p. 102, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 197.

Shell depressed, rounded, with few prominent bulging ribs, which are not developed in the young shell; apex smooth, obtuse, and anterior to center.

Two specimens sent to Dr. Dall were identified by him as the young of this species.

Rare in the lower San Pedro series of Deadman Island; and upper San Pedro series of Los Cerritos and San Pedro. Found in the Pleistocene at Pacific Beach, San Diego; and at Barlow's ranch, Ventura.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Ventura; San Diego (Arnold).

364. **Acmæa spectrum** (*Nuttall*) *Reeve*.

Acmæa spectrum Nutt., Rve., Cpr., Brit. Assn. Rept., 1863, p. 650.

Acmæa spectrum Nutt., Gabb, Pal. Cal., Vol. II, p. 86, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 228. Keep, West Coast Shells, p. 100, figs. 86, 87, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 197.

Acmæa spectrum Rve., Dall, Am. Jour. Conch., Vol. VI, 1871, p. 251, Pl. XIV, fig. 10. Tryon, Man. Conch., Vol. XIII, p. 14, Pl. I, figs. 7-9, 1891.

Shell depressed, with rather acute apex, which is about one-third length of shell from the anterior margin; ribs very prominent and rugose, generally alternating large and small.

Dimensions.—Long. 26 mm.; lat. 19 mm.; alt. 10 mm.

The commonest of the Acmædæ, and easily distinguishable by the prominent, rugose ribs.

Rare in the lower San Pedro series of Deadman Island; and rather common in the upper San Pedro series of Deadman Island and San Pedro.

Living.—Bodega Bay to Lower California (Dall).

Pleistocene.—Santa Barbara;. San Pedro (Cooper): San Pedro (Arnold).

Family LXXXI. LIOTIIDÆ.

Genus **Delphinoidea** *Brown*.

Shell orbicular, depressed, widely umbilicated; spire short; whorls transversely striated or cancellated; aperture round, not nacreous; peristome continuous, simple.

Delphinoidea cancellata Marryat is a characteristic species.

[S. D.] **Delphinoidea coronadoensis**, sp. nov.

Shell minute, orbicular, depressed, milk-white, rather thick for size of shell; spire flattened beneath plane of upper periphery of the body-whorl; whorls two and one-half, nearly circular in cross-section; surface ornamented by numerous subequal, rounded spiral ridges, and very minute transverse lines, the whole giving the surface a cancellated appearance; irregular lines denoting interruption in growth are common on the body-whorl; suture deeply appressed; umbilicus wide, deep; aperture suboval; peristome continuous, rather thick, slightly effuse.

Dimensions.—Maximum diam. 2 mm.; alt. 0.9 mm.

This species, which is the smallest gastropod found in the Spanish Bight Pleistocene, is named for the Coronado peninsula, into which Spanish Bight extends.

Pleistocene.—San Diego (Arnold).

Family LXXXII. PHASIANELLIDÆ.

Genus **Phasianella** *Lamarck.*

Shell elongated, polished, richly colored; whorls convex; aperture oval, not pearly; inner lip callous; outer lip thin; operculum shelly; callous outside, subspiral inside.

Phasianella fulimoides Lam. is a characteristic species.

365. **Phasianella compta** *Gould.*

Phasianella compta GLD., Pac. R. R. Rept., Vol. VI, p. 333, Pl. XI, figs. 25, 26, 1857. CPR., Brit. Assn. Rept., 1863, p. 651. GABB, Pal. Cal., Vol. II, p. 82, 1869. TRYON, Man. Conch., Vol. X, p. 173, Pl. XXXIX, figs 69–72, 1888. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 258. KEEP, West Coast Shells, p. 89, fig. 74, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 199.

Shell small, thin; spire elevated; apex subacute; whorls four, evenly convex; ornamentation consists of eight obsolete spiral ridges crossed by numerous fine oblique, incremental lines; suture depressed, distinct; aperture ovate; outer lip thin; inner lip sharp and effuse, with incrustation extending to umbilical region; a narrow umbilical chink is sometimes present.

Dimensions.—Long. 9.5 mm.; lat. 6 mm.; body-whorl 7 mm.; aperture 4.2 mm. x 2.8 mm.; defl. 45 degrees.

Distinguishable from the genus *Lacuna* by lack of distinct umbilical chink, and by the spiral lines. These lines are slightly oblique and slope anteriorly from the top of the whorl. The Pleistocene shells often retain their coloration of zigzag, irregular, transverse, purple lines.

This species is common in the upper San Pedro series of San Pedro; and in the lower San Pedro series at San Pedro and Deadman Island. Found also in the Pleistocene at Twenty-sixth Street, San Diego.

Living.—San Pedro to Mazatlan (Cooper).

Pleistocene.—San Pedro; San Diego (Cooper; Arnold).

Family LXXXIII. TURBINIDÆ.

Genus **Pachypoma** *Gray.*

Shell trochiform, conical, with moderately elevated spire; base concave, not umbilicated; whorls flattened, rugose, spinously fringed. Operculum oval, subquadrangular, externally convex.

Pachypoma cœlata Chem. is a characteristic species.

366. **Pachypoma inæquale** *Martyn.*

Trochus inæqualis MART., Univ. Conch., Lond., 1784.

Pachypoma inæquale MART., DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 199, Pl. XXIII, figs. 1, 3, 5.

Trochus gibberosus CHEM., Conch. Cab., X, p. 278, vign. 23, 1795.

Pachypoma gibberosum CHEM., CPR., Brit. Assn. Rept., 1863, p. 651. GABB, Pal. Cal., Vol. II, p. 83, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 256. KEEP, West Coast Shells, p. 87, 1892.

Astralium inæquale MART., TRYON, Man. Conch., Vol. X, p. 244, Pl. LVII, figs. 51, 52, 1888.

Shell of moderate size, conical; spire elevated, subacute; whorls five or six, flat, with numerous oblique, rounded, irregular, transverse ridges, with smaller ridges intercalated on lower part of whorls; suture impressed, wavy, distinct; aperture subovate; umbilicus obsolete; base flat, ornamented with several prominent, rounded, rugose spiral ridges with squamose lirulæ between.

Dimensions.—Alt. 23 mm.; lat. 25 mm.; defl. 65 mm.

This species resembles *Pomaulax undosus* quite closely, but may be distinguished from that species by lack of prominent keel on anterior margin of whorl, intercalated transverse ridges, and prominent spiral ridges on base.

Rare in upper San Pedro series of San Pedro.

Living.—Straits of Fuca to Catalina Island (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Williamson; Arnold).

Genus **Pomaulax** *Gray.*

Shell trochiform, elevated, conic, angulated and nodose at the periphery; obliquely ribbed; not umbilicated; inner lip arcuated with a wide callus, which is channeled, anteriorly truncated.

Type, *Pomaulax undosus* Wood.

367. **Pomaulax undosus** *Wood.*

Trochus undosus Wood, Index, Test. Suppl., Pl. LI, fig. 1, 1828; Suppl., p. 16, Pl. V, fig. 1, 1859.
Pomaulax undosus Wood, Cpr., Brit. Assn. Rept., 1863, p. 651. Gabb, Pal. Cal., Vol. II, p. 83, 1869. Tryon, Man. Conch., Vol. X, p. 243, Pl. LVIII, figs. 69, 70, 1888; Syst. and Struct. Conch., Vol. II, p. 308, Pl. LXXX, fig. 33, 1883. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 260. Keep, West Coast Shells, p. 89, fig. 75, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 199.

Shell large, conical; spire elevated, subacute; whorls six or seven, flat with undulating, nodose keel on anterior margin; transverse ridges on upper part of whorl, with small nodes near middle of shell and toward anterior margin; suture appressed, distinct and wavy; keel prominent on body-whorl; base flat, with faint spiral sculpture; aperture subovate; columellar protuberance on some specimens.

Dimensions.—Alt. 40 mm.; lat. 45 mm.; defl. 70 degrees.

This species is characterized by the prominent nodose keel on anterior margin of whorl. Although the living specimens are common, the fossils are rare in this locality.

Upper San Pedro series of San Pedro and Crawfish George's. Found also in the Pleistocene at Pacific Beach, San Diego.

Living.—Santa Barbara to Cape St. Lucas; Monterey ? (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Genus **Leptothyra** *Carpenter.*

Shell small, turbinated, thick; not umbilicated; aperture circular, slightly angulated anteriorly.

Type, *Leptothyra carpenteri* Carpenter.

368. Leptothyra bacula *Carpenter.*

Leptonyx bacula Cpr., Brit. Assn. Rept., 1863, p. 652. Keep, West Coast Shells, p. 87, 1892.
Leptothyra bacula Cpr., Gabb, Pal. Cal., Vol. II, p. 85, 1869. Cooper, 7th Ann Rept. Cal. St. Min., 1888, p. 245. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892. p. 199

Shell small, turreted, thick; surface sculptured by fine spiral lines; no umbilicus; aperture circular, slightly angulated anteriorly.

Dimensions.—Alt. 2 mm ; lat. 2.5 mm.

The specimen from the Pleistocene shows the original pink color of the living shell, and looks very much like a very small *Norrisia norrisii*, except that the *Leptothyra* has no umbilicus.

Distinguishable from *L. carpenteri* and *L. paucicostata* by its much finer spiral sculpture and pinkish color.

One specimen from the lower San Pedro series of Deadman Island; also found in the lower San Pedro series at Los Cerritos. Found in the Pleistocene at bath-house, Santa Barbara.

Living.—Monterey to Catalina Island (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Pedro; Santa Barbara (Arnold).

369. Leptothyra carpenteri *Pilsbry.*

Leptothyra carpenteri Pilsbry, Tryon, Man. Conch., Vol. X, p. 247, Pl. XXXIX *a*, figs. 26–29, 1888; Nautilus, July, 1890. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 199.
Leptothyra sanguineus Linn., Cpr., Brit. Assn. Rept., 1863, p. 652.
Leptothyra sanguinea Cpr., Gabb, Pal. Cal., Vol. II, p. 85. 1869. Tryon, Syst. Conch., Vol. I, Pl. II, p. 312, 1882. Cooper, 7th Ann. Rept. Cal. St. Min., p. 245, 1888. (Not *Leptothyra sanguineus* Linn., Syst. Nat., 1760.)
Leptonyx sanguinea Linn., Keep, West Coast Shells, p. 87, fig. 73, 1892.

Shell small, subconical, thick; spire only slightly elevated; whorls three to four, slightly convex; body-whorl subangulate anteriorly; whorls ornamented by nine to ten fine, spiral ridges; aperture circular; not umbilicated; tubercle on lower portion of outer lip; suture slightly impressed, distinct.

Dimensions.—Alt. 8 mm.; lat. 10 mm.; defl. 100 degrees.

Distinguishable from *L. paucicostata* by larger size, greater number and less prominence of spiral ridges, and by less prominence of suture; distinguishable from *L. bacula* by less number and greater prominence of spiral ridges.

Found in lower San Pedro series at Deadman Island, and San Pedro; and in the upper San Pedro series at San Pedro and Crawfish George's.

Living.—Straits of Fuca to San Diego; Japan (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

370. Leptothyra paucicostata *Dall.*

Leptothyra paucicostata Dall, Am. Jour. Conch., Vol. VII, 1872, p. 131, Pl. XV, fig. 10. Tryon, Man. Conch., Vol. X, p. 248, Pl. LXIII, fig. 27, 1888. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 245.

Shell smaller than *L. carpenteri;* whorls ornamented with very prominent, coarse spiral ridges; a typical specimen showing six on the body-whorl and two small ones in umbilical region; suture deeply impressed, distinct; aperture circular; lip thick, with tubercle on lower part.

Dimensions.—Alt. 4 mm.; lat. 5 mm.; defl. 100 degrees.

Distinguishable from *L. carpenteri* and *L. bacula* by the coarse spiral ribs and deep suture.

Two specimens found in the lower San Pedro series of San Pedro. Found in the Pleistocene at the bath-house, Santa Barbara.

Living.—Santa Cruz to Monterey (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara (Arnold).

Family LXXXIV. TROCHIDÆ.

Genus **Chlorostoma** *Swainson.*

Shell conoidal, profoundly umbilicated, or umbilical region covered by a callosity; whorls smooth or subcarinated, the last subangulated at the base; columellar lip spirally twisted around the umbilicus; outer lip angulated at the base.

Chlorostoma argyrostroma Chemn. is a characteristic species.

371. **Chlorostoma aureotinctum** *Forbes.*

Trochus aureotinctus Fbs., Proc. Zool. Soc., 1850, p. 271. Fischer, Coq. Viv., *Turbo*, p. 94, Pl. XXXI, fig. 1.

Chlorostoma aureotinctum Fbs., Cpr., Brit. Assn. Rept., 1863, p. 652. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. Tryon, Man. Conch., Vol. XI, p. 172, Pl. XXVII, figs. 31–33, 1889. Keep, West Coast Shells, p. 84, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200.

Shell conoidal, spire somewhat elevated; apex obtuse; whorls four, slightly convex; body-whorl subangular at base; surface roughened by prominent, rounded, irregular, transverse ridges, which appress against the antecedent whorls and become obsolete at the angles of the whorl; lower portion of whorl smooth, as is the whole surface of the two posterior whorls; suture distinct; base of body-whorl furrowed with four grooves which show transverse incremental liruke at their bottoms; umbilicus deep and effuse, with bright, yellow stain in the living shell; aperture circular; columellar lip slightly twisted around umbilicus; outer lip with two small tubercles on inner side of base.

Dimensions.—Alt. 10 mm.; lat. 17.5 mm.; defl. 100 degrees.

Rare in upper San Pedro series of San Pedro.

Living.—Santa Barbara to Lower California (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

372. **Chlorostoma brunneum** *Philippi.*

Trochus brunneus Phil., Zeits. Monog. Troch., p. 300, Pl. XLIII, fig. 19, 1848. Lischke, Jap. Meers. Conchyl., p. 99. Fischer, Coq. Viv., p. 365, Pl. CXII, fig. 1.

Chlorostoma brunneum Phil., Cpr., Brit. Assn. Rept., 1863, p. 652. Gabb, Pal. Cal., Vol. II, p. 84, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. Tryon, Man. Conch., Vol. XI, p. 170, Pl. XXVII, figs. 36–38, 1889. Keep, West Coast Shells, p. 83, fig. 69, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XXI, fig. 8.

Shell conoidal, thick; whorls six, slightly convex; slight shoulder posteriorly near suture; ornamentation consists of numerous prominent, fine, oblique, incremental lines; suture impressed, distinct; umbilicus obsolete; base flat; obsolete spiral ornamentation; outer lip thin, effuse.

Dimensions.—Long. 28 mm.; lat. 28 mm.; defl. 65 degrees.

Distinguishable from *C. montereyi*, which it resembles in shape, by more convex whorls, obsolete umbilicus and lack of spiral ornamentation.

This species is rare in the Pliocene of Deadman Island, and in the upper San Pedro series of Deadman Island and Crawfish George's.

Living.—Cape Mendocino to San Diego (Cooper): Japan ? (Tryon).

Pleistocene.—Santa Barbara Island (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

373. **Chlorostoma funebrale** *A. Adams.*

Chlorostoma funebrale A. AD., Proc. Zool. Soc., 1854, p. 316. CPR., Brit. Assn. Rept., 1863, p. 652. GABB, Pal. Cal., Vol. II, p. 84. 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. TRYON, Man. Conch., Vol. XI, p. 170, Pl. XXVIII, figs. 42-44, 1889. KEEP, West Coast Shells, p. 84, fig. 71, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XXI, fig. 7.

Trochus funebralis A. AD., FISCHER, Coq. Viv., p. 173, Pl. LVII, fig. 3.

Shell conoidal, thick, black; whorls five, only slightly convex; ornamentation of eight spiral ridges crossed by fine, oblique lirulæ of growth; suture distinct; base flat; ornamentation same as whorls, with the oblique incremental lines brought into prominence, as a rule; umbilicus obsolete; outer lip effuse, with one prominent and one smaller tubercle near umbilical region; inner lip incrusted.

Dimensions.—Long. 18 mm.; lat. 19 mm.; defl. 74 degrees.

Distinguishable by black color, spiral ridges and obsolete umbilicus.

Rare in the lower San Pedro series of Deadman Island and San Pedro; and in upper San Pedro series of Deadman Island, San Pedro, Los Cerritos, Long Beach, and Crawfish George's. Found also in the Pleistocene at Barlow's ranch, Ventura; and at Pacific Beach, San Diego.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

374. **Chlorostoma funebrale** *A. Adams*, var. **subapertum** *Carpenter.*

Chlorostoma funebrale var. *subapertum* CPR., Brit. Assn. Rept., 1863, p. 652. DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XXI, fig. 6.

Shell resembles *C. funebrale*, but differs in having more prominent spiral ridges, which are usually much more rugose, and in having a prominent umbilical pit.

Found in same localities as *C. funebrale.*

Living.—Vancouver district (Carpenter): West Coast.

Pleistocene.—San Pedro (Arnold).

Shell smaller than *L. carpenteri;* whorls ornamented with very prominent, coarse spiral ridges; a typical specimen showing six on the body-whorl and two small ones in umbilical region; suture deeply impressed, distinct; aperture circular; lip thick, with tubercle on lower part.

Dimensions.—Alt. 4 mm.; lat. 5 mm.; defl. 100 degrees.

Distinguishable from *L. carpenteri* and *L. bacula* by the coarse spiral ribs and deep suture.

Two specimens found in the lower San Pedro series of San Pedro. Found in the Pleistocene at the bath-house, Santa Barbara.

Living.—Santa Cruz to Monterey (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; Santa Barbara (Arnold).

Family LXXXIV. TROCHIDÆ.

Genus **Chlorostoma** *Swainson.*

Shell conoidal, profoundly umbilicated, or umbilical region covered by a callosity; whorls smooth or subcarinated, the last subangulated at the base; columellar lip spirally twisted around the umbilicus; outer lip angulated at the base.

Chlorostoma argyrostroma Chemn. is a characteristic species.

371. **Chlorostoma aureotinctum** *Forbes.*

Trochus aureotinctus Fbs., Proc. Zool. Soc., 1850, p. 271. Fischer, Coq. Viv., *Turbo*, p. 94, Pl. XXXI, fig. 1.

Chlorostoma aureotinctum Fbs., Cpr., Brit. Assn. Rept., 1863, p. 652. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. Tryon, Man. Conch., Vol. XI, p. 172, Pl. XXVII, figs. 31–33, 1889. Keep, West Coast Shells, p. 84, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200.

Shell conoidal, spire somewhat elevated; apex obtuse; whorls four, slightly convex; body-whorl subangular at base; surface roughened by prominent, rounded, irregular, transverse ridges, which appress against the antecedent whorls and become obsolete at the angles of the whorl; lower portion of whorl smooth, as is the whole surface of the two posterior whorls; suture distinct; base of body-whorl furrowed with four grooves which show transverse incremental liruke at their bottoms; umbilicus deep and effuse, with bright, yellow stain in the living shell; aperture circular; columellar lip slightly twisted around umbilicus; outer lip with two small tubercles on inner side of base.

Dimensions.—Alt. 10 mm.; lat. 17.5 mm.; defl. 100 degrees.

Rare in upper San Pedro series of San Pedro.

Living.—Santa Barbara to Lower California (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro (Arnold).

372. **Chlorostoma brunneum** *Philippi.*

Trochus brunneus Phil., Zeits. Monog. Troch., p. 300, Pl. XLIII, fig. 19, 1848. Lischke, Jap. Meers. Conchyl., p. 99. Fischer, Coq. Viv., p. 365, Pl. CXII, fig. 1.

Chlorostoma brunneum Phil., Cpr., Brit. Assn. Rept., 1863, p. 652. Gabb, Pal. Cal., Vol. II, p. 84, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. Tryon, Man. Conch., Vol. XI, p. 170, Pl. XXVII, figs. 36–38, 1889. Keep, West Coast Shells, p. 83, fig. 69, 1892. Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XXI, fig. 8.

Shell conoidal, thick; whorls six, slightly convex; slight shoulder posteriorly near suture; ornamentation consists of numerous prominent, fine, oblique, incremental lines; suture impressed, distinct; umbilicus obsolete; base flat; obsolete spiral ornamentation; outer lip thin, effuse.

Dimensions.—Long. 28 mm.; lat. 28 mm.; defl. 65 degrees.

Distinguishable from *C. montereyi*, which it resembles in shape, by more convex whorls, obsolete umbilicus and lack of spiral ornamentation.

This species is rare in the Pliocene of Deadman Island, and in the upper San Pedro series of Deadman Island and Crawfish George's.

Living.—Cape Mendocino to San Diego (Cooper): Japan ? (Tryon).

Pleistocene.—Santa Barbara Island (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

373. **Chlorostoma funebrale** *A. Adams.*

Chlorostoma funebrale A. AD., Proc. Zool. Soc., 1854, p. 316. CPR., Brit. Assn. Rept., 1863, p. 652. GABB, Pal. Cal., Vol. II, p. 84. 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. TRYON, Man. Conch., Vol. XI, p. 170, Pl. XXVIII, figs. 42-44, 1889. KEEP, West Coast Shells, p. 84, fig. 71, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XXI, fig. 7.

Trochus funebralis A. AD., FISCHER, Coq. Viv., p. 173, Pl. LVII, fig. 3.

Shell conoidal, thick, black; whorls five, only slightly convex; ornamentation of eight spiral ridges crossed by fine, oblique lirulæ of growth; suture distinct; base flat; ornamentation same as whorls, with the oblique incremental lines brought into prominence, as a rule; umbilicus obsolete; outer lip effuse, with one prominent and one smaller tubercle near umbilical region; inner lip incrusted.

Dimensions.—Long. 18 mm.; lat. 19 mm.; defl. 74 degrees.

Distinguishable by black color, spiral ridges and obsolete umbilicus.

Rare in the lower San Pedro series of Deadman Island and San Pedro; and in upper San Pedro series of Deadman Island, San Pedro, Los Cerritos, Long Beach, and Crawfish George's. Found also in the Pleistocene at Barlow's ranch, Ventura; and at Pacific Beach, San Diego.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; Ventura; San Diego (Arnold).

374. **Chlorostoma funebrale** *A. Adams*, var. **subapertum** *Carpenter.*

Chlorostoma funebrale var. *subapertum* CPR., Brit. Assn. Rept., 1863, p. 652. DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200, Pl. XXI, fig. 6.

Shell resembles *C. funebrale*, but differs in having more prominent spiral ridges, which are usually much more rugose, and in having a prominent umbilical pit. Found in same localities as *C. funebrale*.

Living.—Vancouver district (Carpenter): West Coast.

Pleistocene.—San Pedro (Arnold).

375. **Chlorostoma gallina** *Forbes.*

Trochus (Monodonta) gallina FBS., Proc. Zool. Soc., 1850, p. 271, Pl. XI, fig. 8.
Trochus gallina FBS., FISCHER, Coq. Viv., p. 258, Pl. CXI, fig. 1.
Chlorostoma gallina FORBES, CPR., Brit Assn. Rept., 1863, p. 652. TRYON, Man. Conch., Vol. XI, p. 169, Pl. XX, fig. 15; Pl. XXVIII, figs. 52 and 53, 1889. KEEP, West Coast Shells, p. 84, fig 70, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200.

Shell conoidal, thick; whorls five, flat, slightly shouldered posteriorly near suture in some specimens; ornamentation consists of numerous obsolete spiral ridges, and irregular, oblique, transverse ridges of varying prominence; suture distinct; umbilicus nearly obsolete; base flat, same ornamentation as whorls; outer lip effuse, with prominent tubercle near umbilicus.

Dimensions.—Long. 20 mm.; lat. 21 mm.; defl. 80 degrees.

Most specimens show oblique, alternating dark and light, irregular lines, which characterize the living shells.

Rare in upper San Pedro series of San Pedro, Crawfish George's, and Deadman Island. Found in the Pleistocene at Pacific Beach, San Diego.

Living.—Santa Barbara Islands to Lower California (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

376. **Chlorostoma montereyi** *Kiener.*

PLATE X, FIG. 19.

Trochus montereyi KIENER, Species *Trochus*, Pl. XXXIII, figs. 1 and 1*a*. FISCHER, Coq. Viv., p. 104, Pl. XXXIII, fig. 1. TRYON, Man. Conch., Vol. XI, p. 171, Pl. XXVII, figs. 27, 28, 29, 1889.
Omphalius pfeifferi PHIL., CPR., Proc. Zool. Soc., 1856, p. 200.
Chlorostoma pfeifferi PHIL., CPR., Brit. Assn. Rept., 1863, p. 652. GABB, Pal. Cal., Vol. II, p. 84, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 234. KEEP, West Coast Shells, p. 83, 1892.
Chlorostoma montereyensis KIEN., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200.

Shell conical; whorls seven, flat (on some specimens the whorls have a shoulder on the posterior part); suture distinct but not impressed; surface of upper five or six whorls ornamented with five flat, spiral ridges, the space between the ridges being crossed by minute incremental lines, which slope anteriorly at quite an angle; ornamentation on the rest of the whorls indistinct; base flat, indistinctly ornamented as on the upper whorls; umbilicus open, smooth and slightly keeled aperture elliptical.

Dimensions.—Alt. 35 mm.; lat. 33 mm.; defl. 65 degrees.

The specimen described was identified by Dr. Dall.

Found in the Pliocene of Deadman Island; in the lower San Pedro series of Deadman Island; and in the upper San Pedro series of Deadman Island, Crawfish George's, and San Pedro. Found in the Pleistocene at Pacific Beach, San Diego. The specimen figured is from the upper San Pedro series at Crawfish George's, and is now in the collection of Delos Arnold.

Living.—Baulinas Bay to San Diego (Cooper).

Pleistocene.—Santa Barbara to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Pedro (Arnold).

Subgenus **Omphalius** *Philippi.*

Shell convex-trochiform, umbilicated; whorls with revolving series of granules; the last whorl bluntly angulated at the periphery; umbilicus encircled by a callosity; columellar lip terminated by a tooth anteriorly, below which are small tubercles; outer lip usually internally grooved.

Chlorostoma viridulus Gmel. is a characteristic species.

377. **Chlorostoma (Omphalius) viridulum var. ligulatum** *Menke.*

Trochus ligulatus MENKE, Zeit. f. Mal., 1850, p. 173. FISCHER, Coq. Viv., p. 382, Pl. CXV, fig. 5.
Omphalius ligulatus MENKE, CPR., Cat. Mazatlan Shells, p 235.
Omphalius fuscescens PHIL., CPR., Proc. Zool. Soc., 1856, p. 224. CPR., Brit. Assn. Rept., 1863, p. 652. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 255. KEEP, West Coast Shells, p. 82, fig. 68, 1892.
Trochus luridus NUTT., CPR., mss., Brit. Assn. Rept., 1856, p. 233
Chlorostoma (*Omphalius*) *viridulum* var. *ligulatum* MENKE, TRYON, Man. Conch., Vol. XI, p. 177, Pl. XXIX, figs. 58–60, 1889. DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200.

Shell turbinated, thick; whorls five, convex to nearly flat; body-whorl subangular at base; ornamentation consists of seven to eight prominent nodose spiral ridges; suture distinct, sometimes quite deeply impressed; base flat, with ornamentation same as whorls, except less prominent; umbilicus deep, effuse, smooth; outer lip effuse, denticulated on lower portion.

Dimensions.—Alt. 17 mm.; lat. 18 mm; defl. 80 degrees.

Some of the specimens show the mottled coloration of the live shell. Distinguishable by denticulation and ornamentation.

Rare in lower San Pedro series of Deadman Island and San Pedro; common in the upper San Pedro series of Los Cerritos and Crawfish George's; but rare in the upper San Pedro series of Deadman Island and San Pedro.

Living.—Catalina Island to San Diego (Cooper): Mazatlan (Carpenter).

Pleistocene.—San Pedro (Cooper; Arnold).

Genus **Thalotia** *Gray.*

Shell ovate-turriculated, rather thick; not umbilicated; whorls flattened, with revolving ribs, which are sometimes granulated; aperture subrotund; columella tuberculated, truncate in front; outer lip rather thick, crenulated within.

Thalotia conicus Gray is a characteristic species.

378. **Thalotia caffea** *Gabb.*

Turcica (*Ptychstylis*) *caffea* GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 187; Pal. Cal., Vol. II, pp. 16, 84, Pl. III, fig. 27, 1869.
Thalotia caffea GABB, COOPER, Geog. Cat. West Coast Shells, p. 26, 1867. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 267.

Shell conical, thin; spire elevated, subacute; whorls five or six, flat; ornamentation consists of smooth keel on anterior part of whorl and row of nodes on posterior part next to suture; flat space between these two smooth; both keel and flat surface nodose on anterior part of body-whorl; suture very deep and narrow; body-whorl acutely angulated at base; base slightly convex, ornamented with several alternating large and small nodose spiral ridges; aperture trapezoidal; outer lip thin, bulging below; columella incrusted, and having two plications.

Dimensions.—Alt. 19 mm.; lat. 16 mm.; defl. 70 degrees.

Distinguishable from the *Calliostoma* by the deep, narrow suture, large aperture, with bulging lower part of outer lip, and plicated columella.

Found in Pliocene of Deadman Island; one specimen from lower San Pedro series of Deadman Island.

Living.—Monterey (Cooper): San Pedro (Raymond).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Phorcus** *Risso.*

Shell conoidal, umbilicated; umbilicus cylindrical or infundibuliform; whorls frequently tuberculated above and with channeled suture; columella sometimes terminating in a tubercular tooth.

Phorcus magus Linn. is a characteristic species.

379. **Phorcus pulligo** *Martyn.*

Trochus pulligo Mart., Univ. Conch., Pl. LXXVI, 1784. Philippi, Conch. Cab., p. 84, Pl. XV, fig. 3. Fischer, Coq. Viv., p. 232, Pl. LXXX, fig. 1.

Phorcus pulligo Mart., Cpr., Brit. Assn. Rept., 1863, p. 653. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 259.

Chlorostoma pulligo Mart., = *C. marcidus* Gld. (*fide* Tryon, Man. Conch., Vol. XI, p. 171, Pl. XXVI, figs. 23, 24, 25, 1889).

Shell broadly conical; whorls five, flat, but somewhat obsoletely ribbed or bluntly nodose in most specimens; surface shows extremely oblique lines of growth; suture distinct but not much impressed; base flat and smooth, except for faint incremental lines; aperture subovate; lips not thickened; umbilicus smooth, round and effuse.

Dimensions.—Alt. 18 mm.; lat. 22 mm.; defl. 78 degrees.

This shell is often confused with *Chlorostoma montereyi*, but may be distinguished from that species by its gradually expanding umbilicus, greater deflection, and lack of spiral sculpture. Specimens of this species were identified by Dr. Dall.

Rather common in the upper San Pedro series of Crawfish George's. The specimen figured is from the upper San Pedro series at Crawfish George's, and is now in the collection of Delos Arnold.

Living.—Sitka to San Pedro (Cooper.)

Pleistocene.—San Pedro; San Diego (Cooper): San Pedro (Arnold).

Genus **Calliostoma** *Swainson.*

Shell trochiform, conical, not umbilicated; last whorl angulated and usually ribbed at the periphery; aperture quadrangular; columella simple, oblique, often ending in a tooth in front.

Calliostoma zizyphinum Linn. is a characteristic species.

380. **Calliostoma annulatum** *Martyn.*

Trochus annulatus MART., Univ. Conch., Vol. I, fig. 33, 1784. PHILIPPI, Conch. Cab., p. 11, Pl. III, figs. 3, 4.

Zizyphinus annulatus MART., A. ADS., Proc. Zool. Soc., 1851, p. 164. GRAY, Dieffenbach's N. Zealand, p. 237, No. 72.

Calliostoma annulatum MART., CPR., Brit. Assn. Rept., 1863, p. 652. GABB, Pal. Cal., Vol. II, p. 83, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. TRYON, Man. Conch., Vol. XI, p. 363, Pl. LXVII, fig. 43, 1889. KEEP, West Coast Shells, p. 79, fig. 64, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, Pl. XXII, fig. 2.

Shell conical; whorls seven, slightly angulated in center, and ornamented with sharply nodose spiral ridges which increase by intercalation from two on third whorl to seven or eight on body-whorl; suture deep, distinct; body-whorl acutely angulated at base; base nearly flat, ornamented with numerous smooth, rounded spiral lines; aperture subquadrate; columella nearly straight, thickened.

Dimensions.—Alt. 17 mm.; lat. 16 mm.; defl. 67 degrees.

Distinguishable by slightly angulated whorls, nearly equally prominent nodose ridges, and nearly straight columella.

Quite rare in the upper San Pedro series of San Pedro.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro (Arnold).

Pliocene.—San Diego well (Dall).

381. **Calliostoma canaliculatum** *Martyn.*

Trochus canaliculatus MART., Univ. Conch., Vol. I, fig. 32, 1784.

Zizyphinus canaliculatus MART., GRAY, Dieffenbach's N. Zealand, p. 327. REEVE, Conch. Icon., fig. 18.

Calliostoma canaliculatum MART., CPR., Brit. Assn. Rept., 1863, p. 652. GABB, Pal. Cal., Vol. II, p. 83, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. TRYON, Man. Conch., Vol. X, Pl. XLI, fig. 34, 1888; Vol. XI, p. 361, Pl. LXVII, fig. 49, 1889. KEEP, West Coast Shells, p. 80, fig. 65, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, Pl. XXII, fig. 6.

Shell conical; whorls six, flat, ornamented with very prominent rounded, spiral ridges, two on the third and fourth whorls, and then increasing by intercalation until the body-whorl in some specimens has five or six prominent ridges, with a less number of auxiliary riblets in between; suture deeply impressed, forming a canal; aperture subquadrate; base flat, and ornamented in the same way as the whorls; lip as in *C. costatum.*

Dimensions.—Long. 19 mm.; lat. 20 mm.; defl. 67 degrees.

Distinguishable by flat whorls, sutural canal, and few large spiral ridges.

Rare in the Pliocene of Deadman Island, and in the lower San Pedro series of Deadman Island and San Pedro; common in the upper San Pedro series of Deadman Island, San Pedro, Los Cerritos, and Crawfish George's. Found in the Pleistocene at Spanish Bight, and in the Pliocene at Pacific Beach, San Diego.

Living.—Straits of Fuca to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Pedro; San Diego (Arnold).

382. **Calliostoma costatum** *Martyn.*

Trochus costatus MART., Univ. Conch., Pl. X, fig. 3, 1784. PHILIPPI, Conch. Cab., p. 275, Pl. XL, fig. 8.

Calliostoma costatum MART., CPR., Brit. Assn. Rept., 1863, p. 652. GABB, Pal. Cal., Vol. II, p. 83, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. TRYON, Man. Conch., Vol. XI, p. 362, Pl. XVI, figs. 6, 9; Pl. XVIII, fig. 16, 1889. KEEP, West Coast Shells, p. 81, fig. 66, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, Pl. XXII, fig. 1.

Zizyphinus filosus WOOD, REEVE, Conch. Icon., fig. 27.

Shell turbinated, thick; whorls five, convex, and ornamented with about eight, almost equally prominent, spiral ridges; fine oblique incremental lines visible on most specimens; suture deeply impressed; base slightly convex, ornamented same as whorls; outer lip slightly effuse; columella thickened and incrusted.

Dimensions.—Alt. 22 mm.; lat. 20 mm.; defl. 70 degrees.

Distinguishable by the even convexity of the whorls, numerous, comparatively smooth, spiral ridges, and thickness of the shell, which is unusual for a member of this genus.

Rare in the lower San Pedro series of Deadman Island and San Pedro; and in the upper San Pedro series of Crawfish George's, Los Cerritos, and San Pedro. Found in the Pleistocene at Pacific Beach, San Diego.

Living.—Sitka to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Fernando, Los Angeles County (Cooper).

383. **Calliostoma gemmulatum** *Carpenter.*

Calliostoma gemmulatum CPR., Brit. Assn. Rept., 1863, p. 653; Proc. Cal. Acad. Sci., Vol. III, 1864, p. 215. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. TRYON, Man. Conch., Vol. XI, p. 371, Pl. LXVII, fig. 54, 1889. KEEP, West Coast Shells, p. 81, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, Pl. XXII, fig. 3.

Spire more acute than in other species of the genus; whorls six to seven, concave above, convex below; convex part has two or three rows of granular spiral ridges; concave surface ornamented with a few fine granular spiral ridges; suture indistinct; base flat, marked by several smooth spiral ridges; aperture circular.

Dimensions.—Alt. 18 mm.; lat. 15 mm.; defl. 46 degrees.

Found in upper San Pedro series of San Pedro, Los Cerritos, and Crawfish George's. Found in the Pliocene at Packard's Hill, Santa Barbara; and in the Pleistocene at Spanish Bight, San Diego.

Living.—San Pedro to San Diego (Cooper).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego, (Arnold).

Pliocene.—Santa Barbara (Arnold).

384. **Calliostoma tricolor** *Gabb.*

Calliostoma tricolor GABB, Proc. Cal. Acad. Sci., Vol. III, 1865, p. 186; Pal. Cal., Vol. II, p. 17, Pl. III, fig. 28, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 231. TRYON, Man. Conch., Vol. XI, p. 370, Pl. LXVII, fig. 52, 1889. KEEP, West Coast Shells, p. 82, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, Pl. XIX, fig. 8.

Shell conical; spire elevated, subacute; whorls five to six, flat to concave, with prominent, rounded keel on anterior margin; surface ornamented with fine spiral lines; suture impressed, distinct; base nearly flat, ornamented with fine spiral ridges and furrows; aperture subcircular; outer lip thin; columella slightly incrusted.

Dimensions.—Alt. 11 mm.; lat. 11 mm.; defl. 66 degrees.

Distinguishable by the prominent, smooth keel on the anterior part of whorls; and by the concavity and inconspicuous ornamentation of the upper part of the whorls.

Rare in the Pliocene at Deadman Island; in lower San Pedro series at San Pedro; and in upper San Pedro series of Crawfish George's, San Pedro, and Los Cerritos. Found in the Pleistocene at Spanish Bight, San Diego.

Living.—New Year Point to San Diego (Cooper): San Pedro (Arnold).

Pleistocene.—San Pedro to San Diego (Cooper): San Pedro; San Diego (Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Norrisia** *Bayle.*

Shell thick, conoidal, orbicular, covered by an epidermis, smooth; widely umbilicated, umbilicus surrounded by the callous extension of the columella; outer lip not thickened or sculptured within.

Norrisia norrisii Sby. is a characteristic species.

385. **Norrisia norrisii** *Sowerby.*

Trochischus norrisii SBY., Tank. Catalogue, 1825. CPR., Brit. Assn. Rept., 1863, p. 652. = *T. convexus* CPR. (*fide* GABB, Pal. Cal., Vol. II, p. 85, 1869). TRYON, Syst. and Struct. Conch., Vol. II, p. 315, Pl. LXXXI, fig. 64, 1883. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 268. KEEP, West Coast Shells, p. 86, fig. 72, 1892.

Norrisia norrisii SBY., DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 200.

Shell of medium size, conoidal, orbicular, thick; spire only slightly elevated above body-whorl; whorls three or four, only very slightly convex, smooth except for lines of growth; suture only slightly appressed, distinct; aperture subtriangular; outer lip thin, slightly bowed anteriorly; umbilicus large, deep, surrounded by callous extension of the columella.

Dimensions.—Alt. 32 mm.; lat. 40 mm.

Described from a living specimen.

Found in upper San Pedro series at Deadman Island. Found also in the Pleistocene at Pacific Beach, San Diego.

Living.—Santa Barbara to San Diego (Cooper).

Pleistocene.—Santa Barbara (Cooper): San Pedro; San Diego (Arnold).

Genus **Margarita** *Leach.*

Shell thin, globular-conical, umbilicated; whorls rounded, smooth; aperture rounded, pearly; lip sharp, smooth.

Margarita helicina Fabr. is a characteristic species.

386. **Margarita optabilis** *Carpenter*, var. **knechti**, var. nov.

PLATE V, FIG. 14.

Gibbula optabilis CPR., Brit. Assn. Rept., 1863, p. 653.

Shell small, conical, thin; turbinated apical whorls; whorls five; upper whorls rather angular, slightly tabulated above; body-whorl rounded, slightly angulated at base; two prominent spiral ridges, one at angle of whorl, the other near anterior margin; between these two ridges is a slightly concave surface sometimes ornamented with faint spiral ridges; oblique incremental lines quite prominent; suture impressed and distinct; base of body-whorl only slightly convex, and ornamented by five spiral ridges; umbilicus large, deep, effuse, smooth; aperture subrotund; inner lip incrusted and projecting slightly over umbilicus.

Dimensions.—Alt. 8.5 mm.; lat. 8 mm.; body-whorl 6.5 mm.; aperture 4.5 mm.; defl. 70 degrees.

Some of the specimens retain their mottled coloration. The sculpture varies much in this variety, the number of spiral ridges varying; and the ridges sometimes being nodose and sometimes smooth.

Specimens pronounced variety of *M. optabilis* by Dr. Dall.

Common in lower and rare in upper San Pedro series of San Pedro. The specimen figured is the type, which is from the lower San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

387. **Margarita optabilis** *Carpenter*, var. **nodosa**, var. nov.

PLATE V, FIG. 13.

Gibbula optabilis CPR., Brit. Assn. Rept., 1863, p. 653.

Shell small, distinctly conical, thin; whorls five, flat, and ornamented by two prominent slightly nodose spiral ridges, each about one-fourth width of whorl from margin; between these two ribs, and also near the posterior margin of whorl, are less prominent ridges; incremental lines visible; body-whorl angular, with nodose ridge on angle; base of this whorl nearly flat, and ornamented with two prominent nodose spiral ridges and several lesser ones; umbilicus deep, but not very effuse; aperture ovate; inner lip slightly overlapping umbilicus; suture not impressed, indistinct.

Dimensions.—Alt. 6.5 mm.; lat. 6.5 mm.; body-whorl 5 mm.; aperture 3.5 mm.; defl. 75 degrees.

This variety is distinguishable by its simple conical shape, flat whorls, and nodose ridges. It may grade into the turbinated, convex-whorled variety, *M. knechti*, although no mutations have been found in the large series at hand. This form was pronounced a variety of *M. optabilis* by Dr. Dall.

Found in the lower San Pedro series of San Pedro and Deadman Island. The specimen figured is the type, which is from the lower San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

388. Margarita parcipicta *Carpenter*, var. pedroana, var. nov.

PLATE V, FIG. 16.

Gibbula parcipicta CPR., Brit. Assn. Rept., 1863, p. 653; Ann. & Mag. Nat. Hist., 3rd Ser., Vol. XIV, 1864, p. 427.

Shell small, thin, globular, conical; spire elevated, subacute; whorls four, rounded, tabulated near posterior margin; four spiral ridges on upper whorls; suture deeply impressed and distinct; base of body-whorl rounded, and ornamented by fine spiral ridges; umbilicus deep and effuse; aperture subcircular.

Dimensions.—Alt. 5.5 mm.; lat. 5.5 mm.; body-whorl 4.5 mm.; aperture 3 mm.; defl. 80 degrees.

Specimens pronounced variety of *M. parcipicta* by Dr. Dall.

Found in the lower San Pedro series at Deadman Island and San Pedro; and in the upper San Pedro series at Deadman Island, San Pedro, and Los Cerritos. The specimen figured is the type, which is from the lower San Pedro series at San Pedro, and is now in the United States National Museum.

Pleistocene.—San Pedro (Arnold).

389. Margarita pupilla *Gould.*

PLATE X, FIG. 15.

Trochus pupillus GLD., Proc. Bost. Soc. Nat. Hist., Vol. III, 1850, p. 91; Wilkes' Expl. Exped., Vol. XII, p. 186, fig. 208, 1852.

Margarita pupilla GLD., = *M. calostoma* A. ADS. (*fide* CPR., Brit. Assn. Rept., 1863, p. 653). = *M. salmonea* CPR. (*fide* COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 249). TRYON, Man. Conch., Vol. XI, p. 295, Pl. XLIV, figs. 29-32, 1889. KEEP, West Coast Shells, p. 78, fig. 63, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 202.

Shell small, ovate-conic, rather solid; whorls five, convex, flattened slightly above, forming a narrow, tabulate band just below suture; body-whorl obtusely angulated; surface sculptured with small, flattened, subequal, equidistant, revolving ribs, five on the upper whorls; interspaces ornamented by fine, oblique, incremental lines; base of body-whorl nearly flat, and ornamented with numerous fine, revolving lines, which become coarser near umbilicus; suture deeply impressed, distinct; aperture circular; columella somewhat arcuate; umbilicus small, groove-like; outer lip sharp, nacreous layer on inner lip.

Dimensions.—Alt. 5.8 mm.; lat. 8 mm.; defl. 67 degrees.

Somewhat resembles *Solariella peramabilis*, but may be distinguished by smaller umbilicus; flatter, finer sculptured base; whorls less flattened above and finer sculptured, both spiral and transverse. Dr. Dall pronounced the Pliocene specimen a variety of *M. pupilla.*

Found in Pliocene at Deadman Island; two specimens, one of which is figured, and is now in the collection of Delos Arnold. Found also in the Pleistocene at the bath-house, Santa Barbara.

Living.—Alaska to Catalina Island, rare at latter place (Cooper).

Pleistocene.—Santa Barbara (Cooper; Arnold).

Pliocene.—San Pedro (Arnold).

Genus **Solariella** *S. Wood.*

Shell thin, globular-conical; generally with wide crenated umbilicus; whorls rounded, sculptured; aperture rounded; lip sharp, smooth.

Solariella peramabilis Cpr. is a characteristic species.

390. **Solariella cidaris** *A. Adams.*

PLATE VII, FIG. II.

Margarita cidaris A. AD., CPR., Brit. Assn. Rept., 1863, p. 653. CPR., Ann. Mag. Nat. Hist., 3rd Ser., Vol. XIV, 1864, p. 426; Vol. XV, 1865, p. 29. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 249 (young); = *Solariella oxybasis* DALL (*fide* COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 27).

Turcicula cidaris (A. AD.) CPR., TRYON, Man. Conch., Vol. XI, p. 331, 1889.

Solariella cidaris A. AD., WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 202, Pl. XXII, fig. 4.

Shell conical; spire elevated, subacute; whorls six to seven; four upper whorls only slightly convex; lower whorls very convex; surface ornamented with spiral rows of nodes which grade into nodose ribs on the lower side of the body-whorl; suture deeply impressed; aperture circular; outer lip thin; inner lip and columella enameled, the incrustation completely obscuring the small umbilicus in most specimens.

Dimensions.—Alt. 40 mm.; lat. 33 mm.; body-whorl 26.5 mm.; aperture 13 mm.; defl. 66 degrees.

The specimen described and figured is an exceptionally large one, the average altitude being only 18 mm. Identification by Dr. Dall.

Rare in the Pliocene; only about a dozen specimens found, and all of these from the Pliocene of Deadman Island. According to Dr. Cooper, San Marcial is on the peninsula of Lower California, and is in the Tertiary belt. This would correspond to the horizon of the formation at Deadman Island, where they are found only in the Pliocene. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—Neeah Bay to Catalina Island (dredged) (Cooper).

Pleistocene.—San Marcial (Carpenter).

Pliocene.—San Pedro (Arnold; Williamson).

391. **Solariella peramabilis** *Carpenter.*

PLATE VII, FIG. 2.

Solariella peramabilis CPR., Brit. Assn. Rept., 1863, p. 653. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 265. TRYON, Man. Conch., Vol. XI, p. 312, Pl. LXVII, figs. 59–61, 1889. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 202.

Shell small, conical; spire elevated, subacute; whorls five, convex, with narrow tabulate band just anterior to suture, and ornamentation of five or six spiral ribs crossed by fine liruke; suture deeply impressed; aperture circular; umbilicus open, large, with three internal spiral lines.

Dimensions.—Alt. 14.5 mm.; lat. 12 mm.; body-whorl 10.2 mm.; aperture 5 mm.; defl. 82 degrees.

The specimen described was identified by Dr. Dall.

Rare in the Pliocene; four specimens found in the Pliocene of Deadman Island. The specimen figured is from the Pliocene of Deadman Island, and is now in the collection of Delos Arnold.

Living.—Catalina Island (30 fathoms) (Williamson).

Pliocene.—San Pedro (Arnold).

Family LXXXV. CYCLOSTREMATIDÆ.

Genus **Vitrinella** *C. B. Adams.*

Shell minute, depressed turbiniform; widely umbilicated; aperture large, rounded.

Vitrinella anomala d'Orb. is a characteristic species.

392. **Vitrinella williamsoni** *Dall.*

Vitrinella williamsoni DALL, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 202, Pl. XXI, figs. 2 and 3.

"Shell small, white, depressed, with two and a half whorls; spire flattened; suture appressed, with a shallow channel or excavation outside of the appressed margin of the whorl, outside of which the convexity of the whorl rises higher than the suture; base slightly more rounded than the upper side, with a wide and flaring umbilicus; periphery rounded; aperture rounded, oblique; surface polished, finely striated here and there by the incremental lines, which are most prominent above.

"*Dimensions.*—Maximum diameter of shell, 5.5 mm.; minimum diameter, 4.5 mm.; altitude, 1.25 mm."

Several specimens of this species were found in the lower San Pedro series of San Pedro. They were in a perfect state of preservation, and if they had been found on the beach would, no doubt, have been called "dead shells." It is possible that some of the shells reported as "dead on beach" have been washed down from the fossil beds, and have been listed as living.

Found in the upper San Pedro series of San Pedro, and the lower San Pedro series of Deadman Island; rare.

Living.—San Pedro (Williamson).

Pleistocene.—San Pedro (Arnold).

Superfamily ZYGOBRANCHIA.

Family LXXXVI. HALIOTIDÆ.

Genus **Haliotis** *Linné.*

Shell ear-shaped, with a small flat spire; aperture very wide, iridescent; exterior striated, dull; outer angle perforated by a series of holes, those of the spire progressively closed.

Haliotis gigantea Chemn. is a characteristic species.

393. **Haliotis fulgens** *Philippi.*

Haliotis fulgens PHIL., Zeitschr. f. Mal., p. 150, 1845; Abbild. und Beschreib., p. 11, Pls. VII and VIII, fig. 1, 1847. CPR., Brit. Assn. Rept., 1863, p. 574. TRYON, Man. Conch., Vol. XII, p. 81, Pl. XII, figs. 61, 62, 1890. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 198.

Haliotis splendens RVE., Icon. Conch., Pl. III, fig. 9. KEEP, West Coast Shells, p. 90, fig. 76, 1892. WEINKAUFF, Conch. Cab., p. 24, Pls. VII and VIII.

Shell large, flat, oval; spire very slightly raised near margin of shell; surface spirally grooved, the grooves appearing as ridges on the interior; holes four to seven, elevated margins; interior highly colored; outer layer of shell brownish red.

Dimensions.—Long. 112 mm.; lat. 88 mm.; depth 21 mm.

Distinguished from *H. rufescens* and *H. cracheroidii* by grooved surface and colors of interior.

This specimen, which was found in the conglomerate of the upper San Pedro series of Deadman Island, is probably the first authentic record of an *Haliotis* from the Pleistocene of California. It was a perfect specimen when found, but in removing it from the matrix it was unfortunately broken into several fragments. A small but perfect specimen of this species was found in the Pleistocene (upper San Pedro series) at Spanish Bight, San Diego.

Dr. Cooper has reported *H. cracheroidii* and *H. rufescens* from the Pleistocene of San Pedro, but upon examination of the fossils (?) upon which he based his report, which are now in the State Museum Collection at the University of California, they were found to be recent shells from the kitchen-middens that overlie all of the San Pedro fossil deposits. The mistake of reporting kitchen-midden shells as "Pleistocene" and "Pliocene" has been made by a number of collectors, who have mistaken these accumulations for fossil deposits. The two species of *Haliotis* above referred to, besides *H. fulgens*, are common in many of the kitchen-middens along the coast, and especially so in those around San Pedro.

Living.—Monterey to Lower California (Carpenter).

Pleistocene.—San Pedro; San Diego (Arnold).

Family LXXXVII. FISSURELLIDÆ.

Subfamily *FISSURELLIDEINÆ.*

Genus **Lucapina** *Gray.*

Shell oval-oblong, conic, depressed, cancellated; summit subcentral, the oval opening surrounded by a callus; margin crenulated.

Lucapina crenulata Sby. is a characteristic species.

394. **Lucapina crenulata** *Sowerby.*

Fissurella crenulata SBY., Tank. Catalogue, App., p. vi, 1825; Conch. Ill., No. 19, figs. 31, 38, 1831.
Lucapina crenulata SBY., CPR., Proc. Zool. Soc., 1856, p. 223. CPR., Brit. Assn. Rept., 1863, p. 651. GABB, Pal. Cal. Vol. II, p. 85, 1869. TRYON, Struct. and Syst. Conch., Vol. II, p. 326, Pl. LXXXIII, fig. 17, 1883. TRYON, Man. Conch., Vol. XII, Pl. XLIV, figs. 95, 96, 1890. KEEP, West Coast Shells, p. 95, fig. 79, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 198.

Shell large, oval, conical, depressed; surface cancellated with numerous radiating ridges and concentric incremental lines; summit subcentral, the oval opening surrounded by a callus; margin crenulated.

Dimensions.—Long. 90 mm.; lat. 57 mm.; alt. 20 mm.

This species is distinguishable by its large size and rather faint sculpture.

Rare in the upper San Pedro series at Los Cerritos.

Living.—San Pedro to San Diego (Carpenter; Williamson).

Pleistocene.—San Pedro (Arnold).

Subfamily *EMARGINULINÆ.*

Genus **Fissuridea** *Swainson.*

Shell oval, conical, depressed, with the apex in front of the center, and perforated by oblong opening; surface radiated or cancellated; margin crenulated; callosity often truncate, sometimes laminated.

Fissuridea inæqualis Sby. is a characteristic species.

395. Fissuridea aspera *Eschscholtz*.

Fissurella aspera Esch., Zool. Atlas, Vol. V, p. 21, Pl. XXIII, fig. 5, 1833.
Glyphis aspera Esch., Cpr., Proc. Zool. Soc., 1856, p. 223. Cpr., Brit. Assn. Rept., 1863, p. 651. Gabb, Pal. Cal., Vol. II, p. 85, 1869. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 241. Keep, West Coast Shells, p. 96, fig. 80, 1892.
Fissuridea aspera Esch., Williamson, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 197.

Shell oblong, conical; anterior and posterior slopes only very slightly convex; apical hole anterior to center, nearly circular, the plane of its outer rim sloping considerably forward; numerous prominent, straight, rough ribs radiate from the apical hole and produce a corrugated margin for the shell; inner side of rim corrugated and slightly effuse; inner surface smooth.

Dimensions.—Long. 60 mm.; lat. 42 mm.; alt. 23 mm.

Easily distinguishable by its large size and prominent, rough, radiating ridges and alternating color bands. Has fewer and rougher ribs than *F. murina*, and a more elliptical apical hole.

Not uncommon in the lower San Pedro series at Deadman Island and San Pedro; common in the upper San Pedro series at Crawfish George's, and rare in the same formation at Los Cerritos, Deadman Island, and San Pedro.

Living.—Sitka to San Pedro (Cooper).

Pleistocene.—Santa Barbara to San Pedro (Cooper): San Pedro (Arnold).

396. Fissuridea inæqualis *Sowerby*.

Fissurella inæqualis Sby., Proc. Zool. Soc., 1834, p. 126; Conch. Ill., fig. 45. Reeve, Conch. Icon., fig. 50.
Glyphis inæqualis Sby., Cpr., Brit. Assn. Rept., 1856, p. 184, Pl. VII, figs. 4*a*–4*n*. Tryon, Man. Conch., Vol. XII, p. 215, Pl. XXXIV, figs. 63, 64, 1890.
Fissurella pica Sby., Proc. Zool. Soc., 1834, p. 126; Conch. Ill., Vol. II, figs. 32, 33. Reeve, Conch. Icon., fig. 49.
Fissurella inæqualis var. *pica* Sby., Cpr., Brit. Assn. Rept., 1856, p. 184. Tryon, Man. Conch., Vol. XII, p. 215, Pl. XXXIV, fig. 64, 1890.

Shell oblong, conical, much depressed; anterior and posterior surfaces convex; lateral view of margin a line convex upward (as if shell had been on a convex surface); radiating ridges numerous and fine; concentric ridges numerous and nearly as prominent as the radiating ridges; the two systems of lines giving the surface a decidedly cancellate appearance; apical hole slightly oblong, anterior to center; inner surface smooth; inner surface of margin finely corrugated; color white.

Dimensions.—Long. 22.5 mm.; lat. 12 mm.; alt. 6 mm.

Distinguishable from other members of this genus occurring in this formation by its small size and the convex appearance of the sloping sides. The specimen described was identified by Dr. Dall.

Six specimens in the upper San Pedro series of San Pedro; also found in the same horizon at Los Cerritos, Deadman Island, and Long Beach.

Living.—Guacomayo; Galapagos Islands (Carpenter).

Pleistocene.—San Pedro (Arnold).

397. Fissuridea murina (*Carpenter*) *Dall.*

Glyphis densiclathrata var. *murina* CPR., mss.

Fissuridæ murina (CPR.) DALL, Proc. U. S. Nat. Mus., Vol. VIII, 1885, p. 543; Vol. XV, 1892, p. 197.

Glyphis densiclathrata RVE., TRYON, Man. Conch., Vol. XII, p. 215, Pl. XXXIX, fig. 81, 1890 (pars). COOPER, Bull. No. 4, Cal. St. Min. Bureau, Part 3, 1894, p. 27.

Shell resembles *F. aspera* in general outline; apical hole nearly central, circular; radiating ridges numerous and smooth, except for fine incremental lines; inner margin of shell quite evenly crenulated; color white.

Dimensions.—Long. 46 mm.; lat. 30 mm.; alt. 16 mm.

Distinguishable from *F. aspera* by lack of coloration, finer and more numerous ribs, more central and more nearly round apical hole. Smaller than the latter. Dr. Dall says that this is the same species which Californian conchologists have been calling *Glyphis densiclathrata*, but that it is not the same as Reeve's *G. densiclathrata*.

Four specimens in the upper San Pedro series of San Pedro; found in the same horizon at Deadman Island, Los Cerritos, and Crawfish George's; and in the lower San Pedro series at Deadman Island.

Living.—San Pedro; Catalina (Williamson): Santa Barbara (Cooper).

Pleistocene.—San Pedro (Arnold): San Joaquin Bay, Orange County (Bowers).

Genus **Clypidella** *Swainson.*

Shell oval, rugose, slightly elevated, truncated at the anterior extremity; perforation large, subcentral, or somewhat anterior.

Clypidella pustulata Lam. is a characteristic species.

398. Clypidella bimaculata *Dall.*

Clypidella (?) bimaculata DALL, mss., in COOPER, Geol. Cat. W. C. Shells, No. 470, 1866.

Fissurellidæa bimaculata DALL, Am. Jour. Conch., Vol. VII, 1872, p. 132, Pl. XV, fig. VII. KEEP, West Coast Shells, p. 97, fig. 82, 1892.

Clypidella bimaculata DALL, GABB, Pal. Cal., Vol. II, pp. 86, 124, 1869. COOPER, 7th Ann. Rept. Cal. St. Min., 1888, p. 235.

Megatebennus bimaculatus DALL, TRYON, Man. Conch., Vol. XII, p. 183, Pl. XLIV, fig. 94, 1890. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 198.

Shell resembles *C. callomarginata*. Aperture and apical hole elliptical, the latter being central; wide, thickened ridge on inner side of rim and on inner side of apical hole. Smaller than *C. callomarginata*.

Specimens identified by Dr. Dall.

Not uncommon in the lower San Pedro series of Deadman Island and San Pedro; rare in the upper San Pedro series of Los Cerritos and San Pedro.

Living.—Farallon Islands to Santa Barbara Islands (Cooper).

Pleistocene.—Santa Barbara; San Pedro (Cooper): San Pedro (Arnold).

Subclass ISOPLEURA.

Order POLYPLACOPHORA.

Superfamily EOCHITONIA.

Family LXXXVIII. CHITONIDÆ.

Genus **Ischnochiton** *Gray*.

Shell thin; laminæ of insertion regular, acute, neither pectinate nor serrate; eaves large; sinus usually smooth; girdle squamose, the squamæ generally striate.

Ischnochiton longicymoa Blainv. is a characteristic species.

403. **Ischnochiton regularis** *Carpenter*.

Chiton regularis Cpr., Proc. Zool. Soc., 1855, p. 232.
Ischnochiton regularis Cpr., Keep, West Coast Shells, p. 107, fig. 93, 1892. Tryon, Man. Conch., Vol. XIV, p. 142, Pl. XVIII, figs. 41, 46, 1892.

Shell depressed, elongate-oval, width half of length; valves not sharply arched; lateral areas ornamented with concentric, slightly granular ridges and fine radiating lines; central area with inconspicuous fine irregular lines; apex smooth; mucro longitudinally ridged with irregular raised lines.

Description partly from living shell. The only fossil representative of this species so far reported is a perfect central valve found in the upper San Pedro series of San Pedro in 1894 by Dr. G. H. Ashley.

Living.—Monterey (Carpenter): West Coast (Keep).

Pleistocene.—San Pedro (Ashley).

Genus **Cryptochiton** *Midd. & Gray*.

Shell large; valve entirely immersed in the girdle, which is minutely fasciculately pilose.

Type, *Cryptochiton stelleri* Midd.

404. **Cryptochiton stelleri** *Middendorff*.

Chiton stelleri Midd., Bull. Acad. St. Peters., Vol. VI, 1846, p. 116.
Chiton (Cryptochiton) stelleri Midd., Mal. Ross., Pt. 1, p. 93, Pl. I, figs. 1, 2, 1847.
Chiton amiculatus Sby., Thes. Conch., III, *Chitons*, fig. 80.
Chiton sitkensis Rve., Icon. Conch., Pl. X, sp. 55.
Cryptochiton stelleri Midd., Cpr., Brit. Assn. Rept., 1863, p. 648. Gabb, Pal. Cal., Vol. II, p. 87, 1869. Tryon, Struct. and Syst. Conch., Vol. II, p 346, Pl. LXXXV, fig. 83, 1883. Cooper, 7th Ann. Rept. Cal. St. Min., 1888, p. 237. Keep, West Coast Shells, p. 111, fig. 99, 1892. Tryon, Man. Conch., Vol. XV, p. 148, Pl. VII, figs. 7–13; Pl. VI, fig. 6, 1893.
Chiton californicus Prescott, Am. Jour. Sci., 2nd Ser., Vol. XXXVIII, 1864, p. 185.

One valve was found in the lower San Pedro series of Deadman Island, and two in the Pliocene of the same locality. One is probably an end valve and is distinguishable by its strong convexity, thickness, and smooth surface. It has a small, acute notch on each side near the end.

Dimensions.—Long. 20 mm.; lat. 30 mm.; alt. 13 mm.

Living.—Straits of Fuca to Monterey; Kamtschatka (Cooper): Hakodate, Japan (?) (Carpenter).

Pleistocene.—San Diego (Cooper): San Pedro (Arnold).

Pliocene.—Deadman Island, San Pedro (Arnold).

Superfamily OPSICHITONIA.

Family LXXXIX. MOPALIIDÆ.

Genus **Mopalia** *Gray.*

Shell regular; laminæ lengthened; anterior valve with six or more slits, the others with a single slit; last valve sinulate behind; sinus narrow, mucro median, depressed; sutures indented; girdle wide, bristly, sometimes fissured behind, sometimes projecting anteriorly.

Mopalia blainvillei Brod. is a characteristic species.

405. **Mopalia ciliata** *Sowerby.*

Chiton muscosus GLD., Proc. Bost. Soc. Nat. Hist., Vol. II, 1846, p. 145; Wilkes' Expl. Exped., Vol. XII, p. 313, fig. 436, 1852.

Mopalia muscosa GLD., CPR., Brit. Assn. Rept., 1863, p. 648.

Mopalia ciliata SBY., KEEP, West Coast Shells, p. 110, fig. 98, 1892. WILLIAMSON, Proc. U. S. Nat. Mus., Vol. XV, 1892, p. 196.

Shell depressed, rather broad, oval; obliquely ridged along the back; sculpture prominent and covering whole of surface; side areas sculptured with granulated, radiating ridges; central area ornamented with longitudinal, granulated, raised lines; mucro median depressed, ornamented with sharp, oblique lines which meet on middle and form an acute angle open anteriorly; anterior valve large, semicircular, with ten granulated, elevated, radiating lines, and interspaces granulated as in lateral areas.

Dimensions.—Long. 40 mm.; lat. 19 mm.; depth 6 mm.

Description from living specimen. The only specimen of this species ever reported in the fossil state was found in the upper San Pedro series of San Pedro. It is a perfect anterior valve, 10 millimeters wide and 5.2 millimeters long.

Living.—Vancouver to Monterey (Carpenter): San Pedro (Williamson).

Pleistocene.—San Pedro (Arnold).

ARTHROPODA.

Class CRUSTACEA.[1]

Subclass EUCRUSTACEA.

Superorder CIRRIPEDIA.

Order THORACICA.

Family XC. BALANIDÆ.

Genus **Balanus** *Lister.*

Shell low, conical or cylindrical, composed of six pieces. Opercular plates subtriangular; base membranous or calcareous.

406. **Balanus concavus** *Bronn.*

Balanus concavus BRONN, Italiens Tertiar-Gebilde (1831) et Lethæa Geognostica, *b*, II, 3, 1155 (1838), Tab. XXXVI, fig. 12; = *B. cylindraceus* var. *concavus* LAM.; = *Lepas tintinnabulum* BROCCHI, (*fide* DARWIN, Monog. Cerripedia, II, p. 235, Pl. IV, fig. 4*a*–4*e*, 1854).

Shell longitudinally striped with white and pink, or dull purple, sometimes wholly white; scutum finely striated longitudinally; internally, adductor ridge very or moderately prominent.

This is the common pink barnacle of the west coast. Darwin reports this species as fossil from Coralline crag, England; subappenine formations, near Turin, Asti, Colle in Tuscany; Tertiary beds near Lisbon; Tertiary beds, Williamsburg and Evergreen, Virginia; Maryland.

Sometimes found in the upper San Pedro series of San Pedro, Los Cerritos, Crawfish George's, and Deadman Island; also reported from the lower San Pedro series of San Pedro. Found in the Pliocene at Packard's Hill, Santa Barbara; and at Russ School, San Diego; in the Pleistocene at Barlow's ranch, Ventura; and at Spanish Bight and Pacific Beach, San Diego.

Living.—Panama; Peru; San Pedro, California; Philippine Archipelago; Australia (Darwin).

Pleistocene.—San Pedro (Arnold).

---

[1] The classification and generic descriptions of this class, unless otherwise stated, are from Eastman's Zittel's "Text-Book of Paleontology."

Superorder MALACOSTRACA.[1]

Order DECAPODA.

Suborder BRACHYURA.

Subtribe CANCROIDEA.

Section *Cancrini*.

Genus **Cancer** *Linné*.

Carapace transverse, subelliptical, indistinctly areolated; antero-lateral margins regularly arcuated and armed with ten teeth; front narrow, cut into five teeth or lobes; eye-peduncles short, orbits small, with two fissures in both upper and lower margins; antennules longitudinal, or nearly so; basal antennal joint somewhat enlarged and united with the front, thus excluding the short flagellum from the orbit; merus of the maxillipeds distally truncated, and not produced at the antero-external angle; chelipeds subequal, the hand generally costate on the outer surface.

407. **Cancer breweri** *Gabb*.

Cancer breweri Gabb, Pal. Cal., Vol. II, p. 1, Pl. I, fig. 1, 1869. Cooper, 7th Annual Rept. Cal. St. Min., 1888, p. 227.

"Hand shorter, more robust, and broader proportionally than that of *C. magister* Dana; upper margin flattened and bordered by two well-defined ridges, each bearing about four tubercles; outer surface marked by five nearly obsolete ridges minutely tuberculated; fingers shorter than in *C. magister*, the movable one more curved, and both with the denticles nearly obsolete" (Gabb).

Dimensions.—Length of hand 82 mm.

The above description is a copy of Gabb's original. A well preserved hand from the lower San Pedro series of Deadman Island corresponds almost exactly with Gabb's figure of his type. *C. magister* is the common large edible crab of the California coast.

Pleistocene.—San Pedro (Arnold).

Pliocene.—Calleguas ranch, Ventura County (Brewer).

---

[1] Divisions of this suborder and generic description from "Synopsis of California Stalk-Eyed Crustacea." By S. J. Holmes. Occasional Papers, Cal. Acad. Sci., No. VII, p. 47, 1900.

VERTEBRATA.

Class PISCES.

Order ELASMOBRANCHII.

Suborder SELACHII.

Family TRYGONIDÆ.

Genus **Urolophus.**

408. **Urolophus halleri** (?) *Cooper.*

Two stings of this species (one of the common Sting-Rays of the California coast) were found in a perfect state of preservation in the upper San Pedro series at San Pedro. Dr. C. H. Gilbert, who identified the specimens, said that owing to the insufficiency of the evidence offered by the sting alone he was unable to make a definite specific determination.

Pleistocene.—San Pedro (Arnold).

PART III. BIBLIOGRAPHY.

The following Bibliography is intended to give all of the articles which refer either to the geology or paleontology mentioned in this paper. Inasmuch as nearly all of the species found as fossils in the deposits at San Pedro are living at the present time, most of the articles refer to living shells. Dr. Stearns has kindly prepared a complete list of his publications up to January 1, 1901, and as a complete bibliography of his writings has never been published it will be included here under his name.

Many of the references given were taken from the Bibliography of Fossil Mollusca, prepared by the late Dr. James G. Cooper, and published in Bulletin No. 4 of the California State Mining Bureau.

1852. ADAMS, CHAS. B. Catalogue of Panama Shells. *Ann. N. Y. Lyc. Nat. Hist.*, Vol. V, 1852; also separately.

Full notes and descriptions; no figures. Out of nearly 500 species, over 100 were new; but very few of them extend to California, though many of the species are found living or fossil farther north.

1835. ADAMS, HENRY AND ARTHUR. Various articles published in *Proc. Zool. Soc.*, 1835 to 1876.

1853–83. ———The Genera of Recent Mollusca. 2 vols., 8vo, and 138 plates. London, 1853–83.

This fine systematic work contains figures and descriptions of several West Coast mollusca.

1863. AGASSIZ, ALEX. Descriptions of New Echinoderms. *Bull. Mus. Comp. Zool.*, Vol. I, 1863.

1874. ———Revision of the Echini. *Ill. Cat. Mus. Comp. Zool.*, No. 7. Cambridge, 1872–74.

1899. ANDERSON, F. M. The Geology of Point Reyes Peninsula. *Bull. Dept. Geol.*, *Univ. Cal.*, Vol. II, 1897, No. 5, pp. 119–153, Pl. IV.

1902. ARNOLD, DELOS AND RALPH. The Marine Pliocene and Pleistocene Stratigraphy of the Coast of Southern California. *Jour. Geol.*, Vol. X, 1902, No. 2, pp. 117–138, Pls. I–V, figs. 1–7.

1895. ASHLEY, G. H. The Neocene Stratigraphy of the Santa Cruz Mountains of California. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. V, 1895, pp. 273–367, Pls. XXII–XXV.

Also issued in Leland Stanford Junior University Publications, Geology and Paleontology, No. 1, 1895.

1863. BAIRD, WILLIAM. Collections made by Dr. Lyall, Dr. Forbes, R. N., and J. K. Lord, on the Northwest Boundary Survey, Vancouver Island, etc. *Proc. Zool. Soc.*, 1863, p. 66, 12 plates.

Sixteen species described, fourteen figured, but only nine seem to be new.

1863. BINNEY, W. G. Bibliography of North American Conchology. 2 vols., 8vo.

Published by the Smithsonian Institution, 1863–64. This publication catalogues all of the American species named by the authors quoted. Useful for books printed before 1860.

1825–27. Blainville, D. de. Manuel de Malacologie et de Conchyliologie. 2 vols., 8vo, 190 plates. Paris, 1825–27.

1832. —— Living and Fossil Purpuras, etc. *Ann. Nouvelles du Mus. Paris*, Vol. I, 1832, p. 189, with plates.

1878. Bowers, Stephen. Geology of Santa Rosa Island from Notes taken by Dr. Lorenzo G. Yates. *Smithsonian Report* for 1877, pp. 316-320.

1881. Brauns, David. Geology of the Environs of Tokio. *Mem. Sci. Dept., Univ. of Tokio*, No. 4, 1881.

1829. Broderip, W. J., & Sowerby, G. B. *Zool. Jour.*, Vol. IV, 1829, p. 359, descriptions.

Plates of same in Zoology of Captain Beechey's Voyage to the Pacific and Behring's Straits, in the ship "Blossom," 1825–28; published in London in 1839, with the aid of Dr. J. E. Gray.

1830. ——Species Conchyliorum. London, 1830.

Monographs of various genera; 4 to 14 colored plates.

1832–35. ——Descriptions of West Coast Species of Mollusks. *Proc. Zool. Soc.*, 1832–35.

1827. Brown, Thomas. Recent Conchology of Great Britain. 1 vol., 4to, 62 colored plates. Edinburg, 1827. 2nd Ed., London, 1844.

1855. Carpenter, P. P. Descriptions of (supposed) New Species and Varieties of Shells, from the Californian and West Mexican Coasts, principally in the Collection of H. Cuming. *Proc. Zool. Soc.*, 1855, pp. 228-235.

1855–57. ——Catalogue of the Reigen Collection of Mazatlan Mollusca in the British Museum.

Printed by order of the Trustees at the Oberlin Press, Warrington, 1855–1857.

1856*a*. ——First Step toward a Monograph of the Recent Species of Petaloconchus, a Genus of Vermetidea. *Proc. Zool. Soc.*, 1856, pp. 313-317, with woodcuts.

1856*b*. ——Monograph of the Shells collected by T. Nuttall, Esq., on the Californian Coast, in the year 1834-5. *Proc. Zool. Soc.*, 1856, pp. 209-229.

1856*c*. ——Descriptions of Shells from the Gulf of California, and the Pacific Coasts of Mexico and California. Part II. By H. A. Gould, M.D., and P. P. Carpenter. *Proc. Zool. Soc.*, 1856, pp. 198-208.

1856*d*. ——Description of New Species and Varieties of Calyptræidæ, Trochidæ, and Pyramidellidæ, principally in the Collection of Hugh Cuming, Esq. *Proc. Zool. Soc.*, 1856, pp. 166-171.

1856*e*. ——Description of New Species of Shells collected by Mr. T. Bridges in the Bay of Panama and Its Vicinity, in the Collection of Hugh Cuming, Esq. *Proc. Zool. Soc.*, 1856, pp. 159-166.

1856*f*. ——Notes on the Species of Hipponyx inhabiting the American Coasts, with Descriptions of the New Species. *Proc. Zool. Soc.*, 1856, pp. 3–5.

1857. ——Report of the Present State of our Knowledge with Regard to the Mollusca of the West Coast of North America. *Rept. Brit. Assn. Advt. Sci.*, 1856, pp. 159–368, 4 plates.

1858. ——First Step towards a Monograph of the Cæcidea, a Family of the Rostriferous Gasteropoda. (Chiefly from the American seas.) *Proc. Zool. Soc.*, 1858, pp. 413–444.

1863*a*. ——Supplementary Report on the Present State of Our Knowledge with Regard to the Mollusks of the West Coast of North America. *Rept. Brit. Assn. Advt. Sci.*, 1863, pp. 517–686.

Extra copies, with title-page, 1864.

1863*b* ———Review of Prof. C. B. Adams' "Catalogue of the Shells of Panama," from the type specimens. *Proc. Zool. Soc.*, 1863, pp. 339–369.

1864*a*. ———Descriptions of New Marine Shells from the Coast of California. *Proc. Cal. Acad. Sci.*, Vol. III, 1864, pp. 155, 175, 207.

1864*b*. ———Diagnoses of New Forms of Mollusks, Collected at Cape Lucas, Lower California. By Mr. J. Xantus. *Ann. Mag. Nat. Hist.*, 3rd Ser., Vol. XIII, 1864, pp. 311–315, 474–479; Vol. XIV, 1864, pp. 45–49.

1864*c*. ———Contributions toward a Monograph of the Pandoridæ. *Proc. Zool. Soc.*, 1864, pp. 596–603.

1864, 65. ———Diagnoses of New Forms of Mollusca, from the Vancouver District. *Ann. Mag. Nat. Hist.*, 3rd Ser., Vol. XIV, 1864, pp. 423–429; Vol. XV, 1865, pp. 28–32. Also in *Proc. Zool. Soc.*, 1865, pp. 201–204.

1865*a*. ———Diagnoses of New Species and a New Genus of Mollusks, from the Reigen Mazatlan Collection; with an Account of Additional Specimens Presented to the British Museum. *Proc. Zool. Soc.*, 1865, pp. 268–273.

1865*b*. ———Descriptions of New Species and Varieties of Chitonidæ and Acmæidæ from the Panama Collection of the late Prof. C. B. Adams. *Proc. Zool. Soc.*, 1865, pp. 274–277.

1865*c*. ———Diagnoses of New Species of Mollusks, from the West Tropical Region of North America, Principally Collected by the Rev. J. Rowell, of San Francisco. *Proc. Zool. Soc.*, 1865, pp. 278-282.

1865*d*. ———Diagnoses of New Forms of Mollusca from the West Coast of North America. First Collected by Col. E. Jewett. *Ann. Mag. Nat. Hist.*, 3rd Ser., Vol. XV, 1865, pp. 177-182 and 394-399.

1865*e*. ———Diagnoses of New Forms of Mollusca, Collected by Colonel E. Jewett on the West Tropical Shores of North America. *Ann. Mag. Nat. Hist.*, 3rd Ser., Vol. XV, 1865, pp. 399-400.

1865*f*. ———Diagnoses des Mollusques nouveaux provenant de Californie et faisant partie du Musee de l'Institution Smithsonienne. *Jour. de Conch.*, Vol. XII, 1865, pp. 129-149.

1865*h*. ———New Species and Varieties of Mollusca, Collected by the late Dr. Kennerly in Puget Sound. *Jour. Acad. Nat. Sci. Phila.*, New Ser., 1865, p. 54.

1865–73. ———Articles on West Coast Mollusca. *Am. Jour. Conch.*, Vols. I-VII, 1865-1873.

1866. ———On the Pleistocene Fossils Collected by Colonel E. Jewett, at Santa Barbara, California; with Descriptions of New Species. *Ann. Mag. Nat. Hist.*, 3rd Ser., Vol. XVII, 1866, pp. 274-278.

1872. ———Mollusks of Western North America. *Smithsonian Miscellaneous Collections*, Vol. X, 1872, No. 252.

Thirteen reprinted papers of Carpenter's.

1769–95. CHEMNITZ, J. H. (MARTINI & CHEMNITZ.) Conchylien Cabinet. 4to, Nürnburg, 1769 to 1795.

The last date is that of Vol. XI, the only one in which binomial nomenclature is used, Martini not being an authority under Linnéan rules. A new edition begun in 1844 by Kuster, continued by W. Kobelt and Weinkauff to 1887. Nurnburg; 4to, 1,988 colored plates.

1843. CHENU, J. C. Illustrations Conchyliologiques, etc. 79 numbers, folio, colored plates. Paris, 1843.

Living and fossil shells.

Bibliotheque Conchyliologique, a reprint of older authors and their illustrations, including works by Say, Leach, Rafinesque, Conrad, Martin, etc.

1860-62 ——Manuel de Conchyliologie et de Paléontologie. 2 vols., grand 8vo, with about 5000 engravings, part colored. Paris, 1860-62.

1832. CONRAD, TIMOTHY A. Fossil Shells of the Tertiary Formations of North America (Eastern). 1 vol., 56 pages, 18 plates. Philadelphia, 1832.

As many West Coast fossils are very near, or identical with Eastern, they need close comparison.

1837. ——Descriptions of New California Shells. *Jour. Acad. Nat. Sci. Phila.*, Vol. VII, 1837, pp. 227 *et seq.*, 4 plates.

The 45 new species described from California, with figures, form the first important article on West Coast shells.

1849. ——*Report of United States Exploring Expedition*, under Commander Wilkes, Vol. X, Geology. Philadelphia, 1849.

Plates and descriptions of Tertiary fossils from Oregon, many of which have since been found in California.

1856. ——*Report of Explorations and Surveys for a Railroad to the Pacific Coast.* Vol. V, Appendix 2, Fossil Shells and Recent, with 9 plates; Vol. VI, Appendix, p. 69, 5 plates, Fossils; Vol. VII, Part 2, p. 189, 10 plates. Washington, D. C., 1856.

1865-73 ——*Am. Jour. Conch.*, Vols. I to VII, 1865 to 1873.

Several articles on West Coast shells.

1860. COOPER, WILLIAM. *Report of Explorations and Surveys for a Railroad to the Pacific Coast*, Vol. XII, Part 2, No. 6. Report upon Mollusca Collected on the Survey. Washington, 1860. Also separately.

1862. ——Nine New Californian Marine Mollusca. *Proc. Cal. Acad. Sci.*, Vol. II, 1862, pp. 202-207.

1863. ——On New and Rare Mollusca Inhabiting the Coast of California. *Proc. Cal. Acad. Sci.*, Vol. III, 1863, p. 57.

1867. ——Geographical Catalogue of the Mollusca Found West of the Rocky Mountains, between Thirty Degrees and Forty-nine Degrees north latitude. Pamphlet, 4to, 40 pages. San Francisco, 1867.

797 species named.

1870*a*. ——Notes on the Mollusca of Monterey Bay, California. *Am. Jour. Conch.*, Vol. VI, 1870, p. 42.

247 species named.

1870*b*. ——Note on Gadinia and Rowellia. *Am. Jour. Conch.*, Vol. VI, 1870, p. 320.

1874. ——On the Tertiary Geology of California, with Notes on the Characteristic Fossils, etc. *Proc. Cal. Acad. Sci.*, Vol. V, 1874, pp. 172, 389, 401, 422.

1888. ——Catalogue of Californian Fossils. *7th Ann. Rept. Cal. St. Min.* (William Irelan.) Sacramento, 1888.

1890. ——Value of Fossils as Indications of Important Mineral Products. *9th Ann. Rept. Cal. St. Min.* (William Irelan.) Sacramento, 1890.

1894*a*. ——Lists of Fossils in "Gas and Petroleum yielding Formations of the Central Valley of California." By W. L. Watts. *Bull. Cal. St. Min. Bureau*, No. 3, 1894.

1894*b*. ——Catalogue of Californian Fossils. Parts 2, 3, 4 and 5. *Bull. Cal. St. Min. Bureau*, No. 4, 1894.

1897. ——List of Fossils in "Oil and Gas yielding Formations of Los Angeles, Ventura, and Santa Barbara Counties." By W. L. Watts. *Bull. Cal. St. Min. Bureau*, No. 11, 1897, pp. 79-87.

1869. DALL, W. H. Materials for a Monograph of the Family Lepetidæ. *Am. Jour. Conch.*, Vol. V, 1869, pp. 140-150.

1870*a*. ——Review of the Family Siphonariidæ. *Am. Jour. Conch.*, Vol. V, 1870, pp. 30-41, Pls. II, IV, V.

1870*b*. ——Materials for a Monograph of the Family Gadiniidæ. *Am. Jour. Conch.*, Vol. V, 1870, pp. 8-22.

1870*c*. ——Review of the Terebratulidæ and Lingulidæ. *Am. Jour. Conch.*, Vol. V, 1870, pp. 88-168, Pls. VI, VIII.

1871*a*. ——On the Limpets; with Special Reference to the Species of the West Coast of America, and to a More Natural Classification of the Group. *Am. Jour. Conch.*, Vol. VI, 1871, pp. 228-282, Pls. XIV-XVII

1871*b*. ——Diagnoses of Sixty New Forms of Mollusks from the West Coast of America and the North Pacific Ocean. *Am. Jour. Conch.*, Vol. VII, 1871, pp. 93-160, Pls. XIII-XVI.

1871*c*. ——Note on Gadinia. *Am. Jour. Conch.*, Vol. VII, 1871, pp. 192-193.

1872*a*. ——Notes on Californian Mollusca. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, pp. 182-183.

1872*b*. ——Preliminary Descriptions of New Species of Mollusks from the Northwest Coast of America. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, pp. 270-271 and 302-303.

1873*a*. ——Catalogue of the Recent Species of the Class Brachiopoda. *Proc. Acad. Nat. Sci. Phila.*, 1873, pp. 177-204.

1873*b*. ——Descriptions of New Species of Mollusca from the Coast of Alaska, with Notes on Some Rare Forms. *Proc. Cal. Acad. Sci.*, Vol. V, 1873, pp. 57-62.

1874*a*. ——Notes on Tertiary Fossils from the California Coast, with a List of the Species Obtained from a Well at San Diego, California. *Proc. Cal. Acad. Sci.*, Vol. V, 1874, pp. 296-299.

1874*b*. ——Catalogue of Shells from Behring Strait. *Proc. Cal. Acad. Sci.*, Vol. V, 1874, pp. 246-253.

1877*a*. ——Report on the Brachiopoda of Alaska and the Adjacent Shores of Northwest America. *Proc. Acad. Nat. Sci. Phila.*, 1877, pp. 155-170. *Scientific Results*, Art. III, 1877, pp. 45-62.

1877*b*. ——Preliminary Descriptions of New Species of Mollusks from the Northwest Coast of America. *Proc. Cal. Acad. Sci.*, Vol. VII, 1877, p. 6.

1877*c*. ——On the Californian Species of Fusus. *Proc. Cal. Acad. Sci.*, Vol. VII, 1877, p. 5.

1878*a*. ——Descriptions of New Shells from California. *Proc. U. S. Nat. Mus.*, Vol. I, 1878, pp. 46-47.

1878*b*. ——Distribution of Californian Tertiary Fossils. *Proc. U. S. Nat. Mus.*, Vol. I, 1878, pp. 26-30.

1878*c*. ——Report on the Limpets and Chitons of the Alaskan and Arctic Regions, etc. *Proc. U. S. Nat. Mus.*, Vol. I, 1878, pp. 281-344. *Scientific Results*, Art. IV, 1879, pp. 63-126.

1878*d*. ——Post-Pliocene Fossils in the Coast Range of California. *Proc. U. S. Nat. Mus.*, Vol. I, 1878, p. 3.

1878*e*. ——Fossil Mollusks from Later Tertiaries of California. *Proc. U. S. Nat. Mus.*, Vol. I, 1878, pp. 10-16.

1881. ——On the Genera of Chitons. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, pp. 279-291.

1883. ——List of Papers by W. H. Dall, from 1866 to 1882. 3 vols. Washington, 1883.
Reprints of principal papers by this writer.

1884*a*. ——Report on the Mollusca of the Commander Islands, Behring Sea, Collected by Leonhard Stejneger in 1882 and 1883. *Proc. U. S. Nat. Mus.*, Vol. VII, 1884, pp. 340-349, Pl. II.

1884*b*. ——New or Specially Interesting Shells of Point Barrow Expedition. *Proc. U. S. Nat. Mus.*, Vol. VII, 1884, pp. 523-526, Pl. II.

1886*a*. ——Contributions to the Natural History of the Commander Islands. No. 6, Report on Behring Island Mollusca, Collected by Mr. Nicholas Grebnitzki. *Proc. U. S. Nat. Mus.*, Vol. IX, 1886, pp. 209-219.

1886*b*. ——Supplementary Notes on Some Species of Mollusks of the Behring Sea and Vicinity. *Proc. U. S. Nat. Mus.*, Vol. IX, 1886, pp. 297-309, Pls. III-IV.

1889*a*. ——Catalogue of Shell-bearing Marine Mollusks, etc., of Southeastern Coast of the United States. *Bull. U. S. Nat. Mus.*, No. 37, 1889.

1889*b*. ——Preliminary Report on the Collection of Mollusca and Brachiopoda obtained in 1887-88 by the U. S. Fish Commission Steamer "Albatross." *Proc. U. S. Nat. Mus.*, Vol. XII, 1889, pp. 219-362, Pls. V-XIV.

1890. ——Contributions to the Tertiary Fauna of Florida. Part I. Pulmonate, Opisthobranchiate and Orthodont Gastropods. *Trans. Wagner Free Inst. Sci.*, Vol. III, Part I, 1890.

1891. ——On Some New or Interesting West American Shells Obtained from the Dredgings of the U. S. Fish Commission Steamer "Albatross," in 1888, and from Other Sources. *Proc. U. S. Nat. Mus.*, Vol. XIV, 1891, pp. 173-191, Pls. V-VII.

1892*a*. ——and HARRIS, G. D. Correlation Papers. Neocene. *Bull. U. S. Geol. Sur.*, No. 84, 1892.

1892*b*. ——Notes on Geology at La Jolla, San Diego, Cal. *Nautilus*, Vol. VI, No. 4, Aug., 1892, p. 88.

1892*c*. ——Contributions to the Tertiary Fauna of Florida. Part 2. Streptodont and Other Gastropods, Concluded. *Trans. Wagner Free Inst. Sci.*, Vol. III, Part 2, 1882.

1894*a*. ——On the Species of Mactra from California. *Nautilus*, Vol. VII, No. 12, April, 1894, pp. 136-138, Pl. V.

1894*b*. ——Synopsis of the Mactridæ of North America. *Nautilus*, Vol. VIII, No. 3, July, 1894, pp. 25-28; No. 4, Aug., 1894, pp. 39-43.

1894*c*. ——Report on Mollusks and Brachiopoda Dredged in Deep Water Chiefly Near the Hawaiian Islands, with Illustrations of Hitherto Unfigured Species from Northwest America. *Proc. U. S. Nat. Mus.*, Vol. XVII, 1894, pp. 675-733, Pls. XXIII-XXXII.

1895*a*. ——Contributions to the Tertiary Fauna of Florida. Part. 3. A New Classification of the Pelecypoda. *Trans. Wagner Free Inst. Sci.*, Vol. III, Part 3, 1895.

1895*b*. ——Diagnoses of New Species of Mollusks from the West Coast of America. *Proc. U. S. Nat. Mus.*, Vol. XVIII, 1895, pp. 7-20.

1896. ——New Species of Leda from the Pacific Coast. *Nautilus*, Vol. X, No. 1, May, 1896, pp. 1-2.

1897*a*. ——Notice of Some New and Interesting Shells from British Columbia and the Adjacent Region. *Bull. Nat. Hist. Soc. Brit. Columbia*, Vol. II, 1897, pp. 1-18, Pls. I, II.

1897*b*. ———New West American Shells. *Nautilus*, Vol. XI, No. 8, Dec., 1897, pp. 85-86.

1898*a*. ———On a New Species of Fusus from California. *Nautilus*, Vol. XII, No. 1, May, 1898, pp. 4-5.

1898*b*. ———A Table of North American Tertiary Horizons, Correlated with One Another and with Those of Western Europe, with Annotations. *18th Ann. Rept. U. S. Geol. Sur.*, Part II, 1898, pp. 323-348.

1898*c*. ———Synopsis of the Recent and Tertiary Psammobidæ of North America. *Proc. Acad. Nat. Sci. Phila.*, 1898, pp. 57-62.

1898*d*. ———Contributions to the Tertiary Fauna of Florida. Part. 4. Pelecypoda: I, Prionodesmacea; II, Teleodesmacea. *Trans. Wagner Free Inst. Sci.*, Vol. III, Part 4, 1898.

1898*e*. ———Synopsis of the Recent and Tertiary Leptonacea of North America and the West Indies. *Proc. U. S Nat. Mus.*, Vol. XXI, 1898, pp. 873-897.

1899. ———Synopsis of the Solenidæ of North America and the Antilles. *Proc. U. S. Nat. Mus.*, Vol. XXII, 1899, pp. 107-112.

1900*a*. ———Contributions to the Tertiary Fauna of Florida. Part 5. Pelecypoda, Concluded. *Trans. Wagner Free Inst. Sci.*, Vol. VI, Part 5, 1900.

1900*b*. ———Synopsis of the Family Tellinidæ and of the North American Species. *Proc. U. S. Nat. Mus.*, Vol. XXIII, 1900, pp. 285-326, Pls. II-IV.

1901. ———Illustrations and Descriptions of New, Unfigured, or Imperfectly Known Shells, Chiefly American, in the U. S. National Museum. *Proc. U. S. Nat. Mus.*, Vol. XXIV, 1901, pp. 499-566, Pls. XXVII-XL.

1854. DARWIN, CHARLES. A Monograph on the Subclass Cerripedia, with Figures of All the Species. Part II, pp. viii, 684, Pls. XXX. London, 1854.

Printed for the Ray Society.

1839. DESHAYES, G. P. New Species of Shells from West Coast of North America. *Revue Zool.*, 1839.

1840. ———*Magazine de Zoologie*, 1840, Pls. XIV-XCVIII.

Contains illustrations of new shells, and also six previously described by Conrad from the West Coast of North America.

1853-54. ———Catalogue of the Conchifera in the British Museum, Vol. I, 1853; Vol. II, 1854.

1789. DIXON, GEORGE. A Voyage Around the World. London, 1789. Appendix, p. 355, fig. 2.

1874. D'ORBIGNY, ALCIDE. Voyage dans l'Amerique Meridionale, 1826-1833. Mollusca: 4to; 86 colored plates. Paris, 1874.

Also published as a catalogue of the species in the British Museum, by Dr. J. E. Gray, 1854.

1832. DUCLOSE, M. Synopsis of Purpura, giving New Species, etc. *Ann. Sci. Nat.*, Vol. XXIV, 1832, p. 103, with plates.

Also figured in *Mag. de Zool.*, 1833.

1858-71. DUNKER, WILHELM. Novitates Conchological. Series II. 4to, 48 plates. Cassel, 1858-1871.

On marine shells only.

1874-83. ———Monographs on Buccinum, etc. *Zeits. f. Mal.*, 1874-1883.

Also articles in *Chemn. Conch. Cab.*, Ed. 2, on Planorbis, etc.

1900. EASTMAN, CHARLES R. Text-book of Paleontology, by Karl A. von Zittel. Translated and edited by C. R. Eastman. Vol. I, pp. 706, 1476 woodcuts. Macmillan and Co., New York, 1900.

1829. Eschscholtz, J. F. Zoological Atlas. 1 Vol., 4to; 24 plates, 5 of Mollusca. Berlin, 1829.

Completed by Dr. M. H. Rathke, in 1833.

1893. Fairbanks, H. W. Geology of San Diego County; also of Portions of Orange and San Bernardino Counties. *11th Ann. Rept. Cal. St. Min.*, 1893, pp. 76-120.

1896. ———The Geology of Point Sal. *Bull. Dept. Geol. Univ. Cal.*, Vol. II, 1896, No. 1, pp. 1-92, Pls. I-II.

1887. Fischer, Paul. Manuel de Conchyliologie et de Paleontologie Conchyliologique, etc., pp. xxiv + 1369, 23 plates and 1138 text figures. Paris, 1887.

1850. Forbes, Edward. West Coast Shells, Chiefly from Lower California, Collected by Captains Kellet and Wood, R. N., on a Surveying Voyage in Ships "Herald" and "Pandora." *Proc. Zool. Soc.*, 1850, pp. 271-274.

Marine Shells.

1855. ———and Hanley, S. History of British Mollusca and Their Shells. 4 Vols., 8vo, 202 plates. London, 1855.

1861. Gabb, William M. Fossils from California. *Proc. Acad. Nat. Sci. Phila.*, 1861, p. 368.

1865. ———New Marine Shells from the Coast of California. *Proc. Cal. Acad. Sci.*, Vol. III, 1865, p. 183, *et seq.*

1864–69. ———*Geological Survey of California*, J. D. Whitney, State Geologist. Paleontology, Vol. I, 1864; Vol. II, 1869, with 33 plates. Philadelphia, 1864-1869.

1788. Gmelin, J. F. Systema Naturæ. Leipzig, 1788.

1846–51. Gould, Augustus A. Shells Collected by the U. S. Exploring Expedition under Captain Wilkes, U. S. N. *Proc. Bost. Soc. Nat. Hist.*, Vol. II, 1846, p. 142; Vol. III, 1849-50, p. 83; Vol. IV, 1851, p. 27.

1851. ———Shells from the Gulf of California and the Pacific Coast. *Proc. Bost. Soc. Nat. Hist.*, Vol. IV, 1851, p. 87, with plates.

1853. ———Descriptions of Shells from the Gulf of California and the Pacific Coasts of Mexico and California. *Bost. Jour. Nat. Hist.*, Vol. VI, p. 374, 1853.

Separates called Mexican and California Shells.

1852. ———Mollusca and Shells of the U. S. Exploring Expedition, etc. *Report of the Exploring Expedition under Command of Captain Charles Wilkes*, Vol. XII, text. Boston, 1852; plates, 1856.

1862. ———Otia Conchologica. Boston, 1862.

Contains reprinted and corrected descriptions of nearly all of the species named by Dr. Gould, from 1839 to 1862.

1824. Gray, John Edward. Monograph of the Cypræidæ. *Zool. Jour.*, Vol. I, 1824, p. 71.

1826. ———*Annals of Philosophy*, Vol. XII, 1826, p. 103.

1827. ———*Zoological Journal*, Vol. III, 1827.

1839. ———The Zoology of the Voyage of the Ship Blossom, Captain Beechy, pp. 117-138, plates. London, 1839.

1847-49. ———On West Coast Chitonidæ. *Proc. Zool. Soc.*, 1847, p. 66.

1840–44. Haldeman, S. S. Monograph of the Limniades and Other Fresh Water Univalve Shells of North America. Philadelphia, 1840-1844.

1842–56. Hanley, Sylvanus. An Illustrative and Descriptive Catalogue of Recent Bivalve Shells, with 960 figures, by Wood and Sowerby. London, 1842-1856.

Forming an Appendix to Wood's Index Testaceologicus, Ed. 3, 1856.

1855. ———Ipsa Linnæi Conchylia. Royal 8vo, 6 colored plates. London, 1855.

1892. Harris, G. D. and Dall, W. H. Correlation Papers. Neocene. *Bull. U. S. Geol. Sur.*, No. 84, 1892.

1902. Hershey, Oscar H. The Quarternary of Southern California. *Bull. Dept. Geol.*, *Univ. Cal.*, Vol. III, No. 1, 1902, pp. 1-30, Pl. I.

1842–44. Hinds, Richard B. On New Shells from California. *Ann. Mag. Nat. Hist.*, Vol. X, 1842, p. 81, Pl. LXI; Vol XI, 1843, p. 255; Vol. XII, 1843, p. 479; Vol. XIII, 1844, pp. 136 and 468; Vol. XIV, 1844, pp. 8 and 63. Also, *Proc. Zool. Soc.*, 1843-44.

1844. ———Zoology of the Voyage of H. M. S. "Sulphur," under Captain Sir Edward Belcher, 1836-1842. (Vol. II, Mollusca.) 21 plates. London, 1844.

1900. Holmes, Samuel J. Synopsis of California Stalk-Eyed Crustacea. *Occasional Papers Cal. Acad. Sci.*, Vol. VII, 1900.

1835. Jay, J. C. A Catalogue of Recent Shells in his Cabinet, with References and Synonyms. New York, 1835; 2nd Ed., 1836; 3rd Ed., 1839; 4th Ed., 1850.

1856. ———List of Shells. Expedition to Japan under Commodore M. C. Perry, in 1852 to 1854. Vol. II, p. 289, 1856.

1862–69. Jeffreys, J. G. British Conchology. 5 vols., 8vo, 147 plates. London, 1862-1869.

1881. Keep, Josiah. Common Sea Shells of California. 64 pp., 95 figures. San Francisco, 1881.

1892. ———West Coast Shells. 230 pp. 182 figures. San Francisco, 1892.

1834–79. Kiener, L. C. Species Generales et Iconographie des Coquilles Vivantes. 12 Vols., 4to. Paris, 1834-1879.

Continued by P. Fischer.

1897. Kimball, J. P. Physiographic Geology of the Puget Sound Basin. *Am. Geol.*, Vol. XIX, April, 1897, pp. 225-304.

1837. Kuster, H. C. Editor Martini and Chemnitz Conchylien Cabinet. 2nd Ed., 4to, plates, begun in 1837, Nürnburg.

Continued by W. Kobelt and Weinkauff, Nurnburg, to 1887.

1818–22. Lamarck, J. B. P. de. Histoire Naturelle des Animaux sans Vertebres. Vol. V, Conchifera, 1818; Vols. VI and VII, Mollusca. Paris, 1818-22; 2nd Ed. by G. P. Deshayes, Paris, 1835-36; 3rd Ed., Brussels, 1839.

1893. Lawson, A. C. The Geology of Carmelo Bay. *Bull. Dept. Geol. Univ. Cal.*, Vol. I, 1893, pp. 1-59, Pls. I-IV.

1894. ———The Post-pliocene Diastrophism of the Coast of Southern California. *Bull. Dept. Geol. Univ. Cal.*, Vol. I, 1894, No. 4, pp. 115-160, Pls. VIII-IX.

1895. ———Sketch of the Geology of the San Francisco Peninsula. *15th Ann. Rept. U. S. Geol. Sur.*, pp. 399-475, 1895.

1814–17. Leach, William E. The Zoological Miscellany. 3 vols., 150 plates. 1814-1817.

1760. Linnæus, Carl. Systema Naturæ. Vol. I. 10th Ed. Halle et Magdeburg, 1760.

Latest authorized edition is the 12th, 1766-1768.

1784. Martyn, Thomas. The Universal Conchologist. 1 vol., 4to, 77 colored figures. London, 1784.

1825. Mawe, J. The Linnæan System of Conchology. 3rd Ed., with additions and 7 colored plates. London, 1825.

1830. MENKE, C. T. Synopsis Methodica Molluscorum. 2nd Ed. Pyrmont, 1830.

1844-53. ——*Zeitschrift fur Malakozoologie.* 1844-1853.

1898. MERRIAM, JOHN C. The Distribution of the Neocene Sea-urchins of Middle California and Its Bearing on the Classifications of the Neocene Formations. *Bull. Dept. Geol. Univ. Cal.*, Vol. II, 1898, No. 4. pp. 109-118.

1899. ——The Tertiary Sea-urchins of Middle California and the Fauna of the Sooke Beds of Vancouver Island. *Proc. Cal. Acad. Sci.*, 3rd Ser., Geol., Vol. I, 1899, Nos. 5 and 6.

1900. ——Lists of Fossils in "Oil and Gas Yielding Formations of California." By W. L. Watts. *Bull. Cal. St. Min. Bureau*, No. 19, 1900, pp. 218-224.

1847-49. MIDDENDORFF, A. TH. VON. Descriptions of Shells. *Mem. Sci. Nat. Acad. Imp. Sci.*, St. Petersburg, 1847-1849.

Also separate as Beitrage zu einer Malakozoologie Rossica, Part I, 1847; Parts II, III, 1849. Also in Reise in Siberien, II, 1851.

1842. MÖLLER, H. P. C. Index Molluscorum Grœnlandiæ. Copenhagen, 1842.

1803. MONTAGU, G. Testacea Britannica, or Natural History of British Shells. 2 vols., 4to, 16 colored plates. London, 1803.

1859. MORCH, O. A. L. *Malakozoologische Blätter*, Vol. VI, 1859.

1861-62. ——Review of the Family Vermetidæ. (Parts I, II, III.) *Proc. Zool. Soc.*, 1861, pp. 145-181; pp. 326-365; 1862, pp. 54-83.

1858-70. ——Novitates Conchologicæ, Series II, 1858-1870.

Silka Shells by Morch and Dunker.

1856. ——NUTTALL, THOMAS. Carpenter describes shells from Nuttall's manuscript names, *Proc. Zool. Soc.*, 1856.

1885. ORCUTT, CHAS. R. Notes on the Mollusks of the Vicinity of San Diego, California, and Todos Santos Bay, Lower California. *Proc. U. S. Nat. Mus.*, Vol. VIII, 1885, pp. 534-552, Pl. XXIV.

1850-53. PETIT, L. Recent and Fossil Shells. *Jour. de Conch.*, 1850-53, colored plates.

1842-51. PHILIPPI, R. A. and E. B. Abbildungen und Beschreibungen Conchylien, etc. 3 vols., 4to, with 44 plates. Cassel, 1842-1851.

Published in parts. Also in German and English journals, 1845 to 1853.

1853-72. RECLUZ, M. C. *Jour. de Conch.*, 1st Ser., 1853-1872.

The journal is still issued by Crosse and Fischer.

1848. REDFIELD, JOHN H. *Ann. N. Y. Lyc. Nat. Hist.*, Vol. IV, 1848, p. 163.

Also later articles on Marginella.

1842-46. REEVE, LOVELL A., and SOWERBY, G. B. Descriptions of West Coast Shells. *Proc. Zool. Soc.*, 1842-46.

Repeated in Annals of Natural History.

1843-78. ——Conchologia Iconica. London, 1843 to 1878.

Continued since 1865, by Sowerby.

1835-38. SARS, M. and G. O. Works on Mollusca of Norway. 8 vols. and many plates. Bergen and Christiania, 1835-1838.

1817. SAY, THOMAS. On Conchology in Nicholson's Encyclopedia. Vol. II, Pl. LXIX, fig. 6. Philadelphia, 1817.

1880. SMITH, E. A. Descriptions of Twelve New Species of Shells. *Proc. Zool. Soc.*, 1880.

1888. SMITH, W. S. T. A Geological Sketch of San Clemente Island. *18th Ann. Rept. U. S. Geol. Sur.*, Part II, 1898, pp. 465-494.

1900. ——A Topographic Study of the Islands of Southern California. *Bull. Dept. Geol. Univ. Cal.*, Vol. II, 1900, No. 7, pp. 179-230, Pl. V.

1825. SOWERBY, GEORGE B. A Catalogue of the Shells in the Collection of the Earl of Tankerville, with an Appendix Describing New Species. Small 4to, 9 plates, colored. London, 1825.

1838-39. ——Monograph of the Genus Margarita. *Malacological Magazine*, Part II. London, 1838-39.

1832-41. ——and G. B., Jr. The Conchological Illustrations, colored figures, of all hitherto Unfigured Recent Shells. 2 vols., 12mo., 200 plates. London, 1832-1841.

1839. ——A Conchological Manual. Illustrated by 500 figures. London, 1839.

1842-59. ——Thesaurus Conchyliorum, or Figures and Descriptions of Shells. London, 1842-1859.

1812-29. SOWERBY, JAMES, and DE CARLS, JAMES. The Mineral Conchology of Great Britain. 12 vols., 8vo., 648 colored plates. London, 1812-1829.

1820-35. ——The Genera of Recent and Fossil Shells. 2 vols., 8vo. London, 1820-1834. Also, *Zool. Jour.*, 1825-1835, 5 vols., 8vo., with colored plates.

1866*a*. STEARNS, ROBERT E. C. List of Shells Collected at Baulinas Bay, California, June, 1866. *Proc. Cal. Acad. Sci.*, Vol. III, 1866, pp. 275-276.

1866*b*. ——List of Shells Collected at Santa Barbara and San Diego by Mr. J. Hepburn, in February-March, 1866, with Remarks upon Some of the Species. *Proc. Cal. Acad. Sci.*, Vol. III, 1866, pp. 283-286.

1867*a*. ——Remarkable Instance of Vitality in a Snail. *Proc. Cal. Acad. Sci.*, Vol. III, 1867, pp. 328-329.

1867*b*. ——Shells Collected at Santa Barbara by W. Newcomb, M. D., in January, 1867. *Proc. Cal. Acad. Sci*, Vol. III, 1867, pp. 343-345.

1867*c*. ——List of Shells Collected at Purissima and Lobitas, California, October, 1866. *Proc. Cal. Acad. Sci.*, Vol. III, 1867, pp. 345-346.

1867*d*. ——List of Shells Collected at Bodega Bay, California, in June. *Proc. Cal. Acad. Sci.*, Vol. III, 1867, pp. 382-383.

1867*e*. ——Shells Collected by the U. S. Coast Survey Expedition to Alaska in the Year 1867. *Proc. Cal. Acad. Sci.*, Vol. III, 1867, pp. 384-385.

Also in Report of the Superintendent of the U. S. Coast Survey, for 1867; Appendix No. 18, pp. 291-2.

1869*a*. ——Shell Money. *Am. Nat.*, Vol. III, No. 1, March, 1869, pp. 1-5.

1869*b*. ——The Haliotis, or Pearly Ear-Shell. *Am. Nat.*, Vol. III, No. 5, July, 1869, pp. 250-256, with figures.

1871*a*. ——Description of a New Species of Monocera from California, with Remarks on the Distribution of North American Species. *Am. Jour. Conch.*, Vol. VII, 1872, pp. 167-171, with figures.

1871*b*. ——Descriptions of New California Shells. *Am. Jour. Conch.*, Vol. VII, 1872, pp. 172-173, with figures.

1871*c*. ——On the Habitat and Distribution of the West American Species of Cypræidæ, Triviidæ, and Amphiperastidæ, etc., etc. *Proc. Cal. Acad. Sci.*, Vol. IV, 1871, pp. 186-189.

1872*a*. ——Description of a New Species of Mangelia from California. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, p. 226, with figure.

1872*b*. ——Remarks on Marine Faunal Provinces on West Coast of America. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, p. 246.

1872*c*. ——Descriptions of New Species of Shells from California. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, p. 249.

1872*d*. ——Notes on Purpura canaliculata of Duclos. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, pp. 250-251.

1872*e*. ——A Partial Comparison of the Conchology of Portions of the Atlantic and Pacific Coasts of North America. *Proc. Cal. Acad. Sci.*, Vol. IV, 1872, pp. 271-273.

1872*f*. ——The Californian Trivia and Some Points in Its Distribution. *Am. Nat.*, Vol. VI, December, 1872, pp. 732-734, with figures.

1873*a*. ——Descriptions of a New Genus and Two New Species of Nudibranchiate Mollusks from the Coast of California. *Proc. Cal. Acad. Sci.*, Vol. V, 1873, pp. 77-78, with figures.

1873*b*. ——Descriptions of New Marine Mollusks from the West Coast of North America. *Proc. Cal. Acad. Sci.*, Vol. V, 1873, pp. 78-82, with plate.

1873*c*. ——On Xylophagous Marine Animals. *California Horticulturist*, etc., May, 1873, with figures.

1873*d*. ——Remarks on the Nudibranchiate or Naked-gilled Mollusks. *California Horticulturist*, July, 1873.

1873*e*. ——Aboriginal Shell-money. *Proc. Cal. Acad. Sci.*, Vol. V, 1873, pp. 113-120, with plate.

1873*f*. ——Shells Collected at San Juanico, Lower California, by William M. Gabb. *Proc. Cal. Acad. Sci.*, Vol. V, 1873, pp. 131-132.

1873*g*. ——Shells Collected at Loreto, Lower California, by W. M. Gabb in February, 1867. *Proc. Cal. Acad. Sci.*, Vol. V, 1873, p. 132.

1873*h*. ——Aboriginal Shell-money. *Overland Monthly*, San Francisco, Sept., 1873, with figures.

Also in *Globus*, Braunschweig, Germany, of about same date; without credit.

1875*a*, 77. ——On the Vitality of Certain Land Mollusks. *Proc. Cal. Acad. Sci.*, Vol. VI, 1875, pp. 185-187, with plate. *Am. Nat.*, Vol. XI, Feb., 1877, pp. 100-102.

1875*b*. ——Description of New Fossil Shells from the Tertiary of California. *Proc. Acad. Nat. Sci. Phila.*, 1875, pp. 463-464, with plates.

1877*a*. ——Aboriginal Shell-money. *Am. Nat.*, Vol. XI, June, 1877, pp. 344-350, with figures and plate.

1877*b*. ——Aboriginal Shell Ornaments, and Mr. F. A. Barber's paper thereon. *Am. Nat.*, Vol. XI, Aug., 1877, pp. 473-474.

1878. ——Description of a New Species of Dolabella from the Gulf of California, with Remarks on Other Rare or Little Known Species from the Same Region. *Proc. Acad. Nat. Sci. Phila.*, 1878, pp. 395-401, Pl. VII.

1879*a*. ——Remarks on Fossil Shells from the Colorado Desert. *Am. Nat.*, Vol. XIII, 1879, pp. 141-154; several figures.

Read before the California Academy of Sciences.

1879*b*. ——Description of a New Species or Variety of Land Snail from California (Helix circumcarinata). *Ann. N. Y. Acad. Sci.*, Vol. I, 1879, pp. 316-317, 3 figures.

1881*a*. ———Observations on Planorbis; are the Shells of Planorbis Dextral or Sinistral? On Certain Aspects of Variation in American Planorbes. *Proc. Acad. Nat. Sci. Phila.*, 1881, pp. 92-110, with 27 figures.

1881*b*. ———Mya arenaria in San Francisco Bay. *Am. Nat.*, Vol. XV, May, 1881, pp. 362-366.

1881*c*. ———On Helix aspersa in California, and the Geographical Distribution of Certain West American Land Snails, etc. *Ann. N. Y. Acad. Sci.*, Vol. II, 1881, pp. 129-139.

1882*a*. ———Verification of the Habitat of Conrad's Mytilus bifurcatus. *Proc. Acad. Nat. Sci. Phila.*, 1882, pp. 241-242.

1882*b*. ———On the History and Distribution of the Fresh-Water Mussels and the Identity of Certain Alleged Species. *Proc. Cal. Acad. Sci.*, November 20, 1882, 21 pages and figures.

1883*a*. ———On the Shells of the Colorado Desert and the Region Farther East; Part I. The Physas of Indio; Part II. Anodonta californiensis in a New Locality. *Am. Nat.*, Vol. XVII, Part 2, October, 1883, pp. 1014-1020.

Read before the California Academy of Sciences, June 5, 1883.

1883*b*. ———The Edible Clams of the Pacific Coast, and a Proposed Method of Transplanting Them to the Atlantic Coast. *Bull. U. S. Fish Com.*, Vol. III, 1883, pp. 353-362, with several figures.

Letter to Prof. Spencer F. Baird, U. S. Fish Commissioner, October 14, 1882.

1883*c*. ———Description of a New Hydrobinoid Gasteropod from the Mountain Lakes of Nevada, with Remarks on Allied Species and the Physiographical Features of Said Region. *Proc. Phil. Acad. Nat. Sci. Phila.*, 1883, pp. 171-176, with figures.

1883*d*. ———Fresh-Water Pearl Mussels. *Mining and Scientific Press*, San Francisco, April 7, 1883.

1885*a*. ———The Giant Clams of Puget Sound. *Forest and Stream*, May 28, 1885.

Read at the Washington, D. C., meeting of the American Fisheries Society, April, 1865.

1885*b*. ———The Helicidæ of the John Day Fauna. Contained in Dr. Charles A. White's paper, "On Marine Eocene, Fresh-Water Miocene, and other Fossil Mollusca of Western North America." *Bull. U. S. Geol. Sur.*, No. 18, 1885, pp. 14-18, Pl. III.

1886. ———The Teredo, or Ship-worm. *Am. Nat.*, February, 1886, pp. 131-136, with figures.

From letter to Prof. Spencer F. Baird, Society Smithsonian Institution.

1887. ———Ethno-Conchology—a Study of Primitive Money. *Rept. U. S. Nat. Mus.*, 1887, pp. 297-334, Pls. I-IX, and numerous text-figures.

1889*a*. ———Helix (Stenotrema) hirsuta Say on the West Coast. *Nautilus*, Vol.—, November, 1889, pp.—.

1889*b*. ———Notice and Comments on the Distribution of Planorbis (Helisoma) bicarinatus Say. *West American Scientist*, September, 1889.

1890*a*. ———Descriptions of New West American Land, Fresh-Water and Marine Shells, etc. Scientific Results of Explorations by the U. S. Fish Commission Steamer "Albatross." *Proc. U. S. Nat. Mus.*, Vol. XIII, 1890, Pls. XV-XVII, pp. 205-225.

1890*b*. ———On the Nishinam Game of "Ha" and the Boston Game of "Props." *Am. Anthropologist*, October, 1890, pp. 353-358, with figures.

1891*a*. ———List of American Land and Fresh-water Shells Received from the U. S. Department of Agriculture, etc. *Proc. U. S. Nat. Mus.*, Vol. XIV, 1891, pp. 95-106.

1891*b*. ——List of Shells Collected on the West Coast of South America, Principally between Latitudes 7° 30′ S., and 8° 49′ N., by Dr. W. H. Jones, U. S. Navy. *Proc. U. S. Nat. Mus.*, Vol. XIV, 1891, pp. 307-335.

1891*c*. ——Notes on the Sculpture of American Limnæas, etc. *Nautilus*, Vol. IV, March, 1891, pp. 121-124.

1892*a*. ——Patula strigosa Gould, in Arizona. *Nautilus*, Vol. VI, May, 1892, p. 1.

1892*b*. ——Preliminary Descriptions of New Molluscan Forms from West American Regions. *Nautilus*, Vol. VI, December, 1892, pp. 85-89.

1893*a*. ——Description of a New Species of Nassa (Nassa brunneostoma) from the Gulf of California. *Nautilus*, Vol. VII, May, 1893, pp. 10-11.

1893*b*. ——Report on the Land and Fresh-water Shells of the Death Valley Expedition. *North Am. Fauna*, No. 7, 1893, pp. 269-283.

Issued by U. S. Dept. Agric., Division of Ornithology and Mammalogy.

1893*c*. ——Preliminary Report on the Molluscan Species Collected by the United States Scientific Expedition to West Africa in 1889–90. *Proc. U. S. Nat. Mus.*, Vol. XVI, 1893, pp. 317-339.

1893*d*. ——On Rare or Little Known Mollusks from the West Coast of North and South America, with Descriptions of New Species. *Proc. U. S. Nat. Mus.*, Vol. XVI, 1893, pp. 341-352, Pl. I.

1893*e*. ——Report on the Mollusk Fauna of the Galapagos Islands, with Descriptions of New Species. Scientific Results of Explorations by the U. S. Fish Commission Steamer "Albatross." *Proc. U. S. Nat. Mus.*, Vol. XVI, 1893, pp. 353-450, Pls. LI-LII.

1893*f*. ——Notes on Recent Collections of North American Land, Fresh-water, and Marine Shells, Received from the U. S. Department of Agriculture. *Proc. U. S. Nat. Mus.*, Vol. XVI, 1893, pp. 743-755.

1894*a*. ——Triodopsis + Mesodon, Distribution, etc. *Nautilus*, Vol. VIII, May, 1894, pp. 6-8.

1894*b*, 99. ——Urosalpinx cinereus in San Francisco Bay. *Nautilus*, Vol. VIII, June, 1894, pp. 13-14; Vol. XII, Feb., 1899, p. 112.

1894*c*. ——Helix (Arionta) coloradoensis:—A New Locality. *Nautilus*, Vol. VIII, July, 1894, p. 29.

1894*d*. ——The Shells of the Tres Marias and other Localities along the Shores of Lower California and the Gulf of California. *Proc. U. S. Nat. Mus.*, Vol. XVII, 1894, pp. 139-204.

1894*e*. ——Mollusk Fauna of the Galapagos Islands. *West American Scientist*, April, 1894.

1895. ——A New Variety of Ocinebra circumtexta Stearns. *Nautilus*, Vol. IX, June, 1895, p. 16.

1897. ——Uvanilla regina—A New Locality. *Nautilus*, Vol. XI, May, 1897, pp. 1-2.

1898*a*. ——Description of New Species of Actæon from the Quarternary Bluffs of Spanish Bight, San Diego, California. *Proc. U. S. Nat. Mus.*, Vol. XXI, 1898, pp. 297-299, with figures.

Also preliminary descriptions in *Nautilus*, Vol. XI, June, 1897, pp. 14-15.

1898*b*. ——Notes on Cytherea (Tivela) crassatelloides Conrad, with Descriptions of Many Varieties. *Proc. U. S. Nat. Mus.*, Vol. XXI, 1898, pp. 371-378, Pls. XXIII-XXV.

1899*a*. ——Crepidula convexa Say, var. glauca Say, San Francisco Bay. *Nautilus*, Vol. XIII, May, 1899, p. 8.

1899*b*. ———Natural History of the Tres Marias Islands, Mexico. *Nautilus*, Vol. XIII, June, 1899, pp. 19-20.

Also in *Science*, N. S., Vol. X, 1899, No. 239, p. 121.

A criticism of Nelson and Goldman's paper in *N. A. Fauna*, No. 14.

1899*c*. ———Donax stultorum Mawe:—Conrad's Species, Cytherea crassatelloides. *Nautilus*, Vol. XIII, November, 1899, pp. 73-75.

Contains bibliography of this species.

1899*d*. ———Abalone Fishery in California:—Protective Regulation. *Nautilus*, Vol. XIII, November, 1899, p. 81.

1899*e*. ———Modiola plicatula Lamarck, in San Francisco Bay. *Nautilus*, Vol. XIII, December, 1899, p. 86.

See also, *Nautilus*, Vol. XII, 1898, pp. 102-103.

1899*f*. ———Description of a New Variety of Haliotis from California, with Faunal and Geographical Notes. *Proc. U. S. Nat. Mus.*, Vol. XXII, 1899, pp. 139-142.

Also, *Nautilus*, Vol. XII, 1899, pp. 106-107.

1900*a*. ———Exotic Mollusca in California. *Science*, N. S., Vol. XI, 1900, No. 278, pp. 655-659.

1900*b*. ———Notes on the Saxidomi of the West Coast. *Nautilus*, Vol. XIV, May, 1900, pp. 1-3.

1900*c*. ———The Fossil Shells of the Los Angeles Tunnel Clays. *Science*, N. S., Vol. XII, 1900, No. 294, pp. 247-250.

1900*d*. ———Vallonia pulchella Müll., in Los Angeles and elsewhere in California. *Nautilus*, Vol. XIV, October, 1900, pp. 65-67.

1900*e*. ———Fossil Land-Shells of the John Day Region, with Notes on Related Living Species. *Proc. Wash. Acad. Sci.*, Vol. II, 1900, pp. 651-660, Pl. XXXV.

1850-52. STIMPSON, WILLIAM. Descriptions of Marine Mollusks. *Proc. Bost. Soc. Nat. Hist.*, Vol. III, 1850; Vol. IV, 1851-1852.

1857. ———Crustacea and Echinoderms of the Pacific Coast, 1857.

1820-33. SWAINSON, WILLIAM. Zoological Illustrations. The shells in 5 parts, 4to, 40 colored plates. London, 1820-1833.

1834. ———Exotic Conchology, or Drawings of Rare Shells, etc. 4to, 48 plates. London, 1834.

Second edition by Hanley, 1841.

1855. TRASK, J. B. Descriptions of Californian Fossil Shells. *Proc. Cal. Acad. Sci.*, Vol. I, 1855, pp. 40-42.

1862. TRYON, GEO. W. A Monograph of the Order Pholadacea, etc. 1 vol., 8vo, 1 plate. Philadelphia, 1862.

1865-72. ———Editor *American Journal of Conchology*. 1865-1872. 7 vols., 8vo, plates.

1879-95. ———Manual of Conchology, Structural and Systematic. Philadelphia, 1879-1895.

Sixteen volumes on marine mollusks, twelve other volumes on land shells.

1882-84. ———Structural and Systematic Conchology. 3 vols. Philadelphia, 1882-1884.

1833. VALENCIENNES, A. Recueil d'Observations de Zoologie, etc. Par Al. de Humboldt et A. Bonpland. Vol. II. Paris, 1833.

1846. ———Voyage au tour du Monde sur la "Venus" pendant les annees 1836-1839. Par M. du Petit Thouars. 24 plates. Issued in 1846.

1899. VAUGHAN, T. W. A New Species of Caryophyllia from California. *Proc. U. S. Nat. Mus.*, Vol. XXII, 1899, pp. 199-203.

1900. ———The Eocene and Oligocene Coral Faunas of the United States, etc. *U. S. Geol. Surv.*, Monograph XXXIX.

1894. Watts, W. L. The Gas and Petroleum Yielding Formations of the Central Valley of California. *Bull. Cal. St. Min. Bureau*, No. 3, 1894.

1897. ———Oil and Gas Yielding Formations of Los Angeles, Ventura, and Santa Barbara Counties. *Bull. Cal. St. Min. Bureau*, No. 11, 1897.

1900. ———Oil and Gas Yielding Formations of California. *Bull. Cal. St. Min. Bureau*, No. 19, 1900.

1865. Whitney, J. D. *Geological Survey of California.* Vol. I, Geology. Philadelphia, 1865.

1892. Williamson, Mrs. M. B. An Annotated List of the Shells of San Pedro Bay and Vicinity. *Proc. U. S. Nat. Mus.*, Vol. XV, 1892, pp. 179 220, Pls. XIX-XXIII.

1902. ———A Monograph on Pecten æquisulcatus Carpenter. *Bull. So. Cal. Acad. Sci.*, Vol. I, No. 5, May 1, 1902, pp. 51-64, Pls. IV-VI.

1859*a*. Wood, William. General Conchology. Royal 8vo, 59 colored plates. London, 1859.

1859*b*. ———Index Testaceologicus; Catalogue of Shells According to the Linnæan System. 8vo, 2 300 colored figures. London, 1859.

1886-87. Wood, Searles V. Monograph of the Crag Mollusca. 4to, 5 parts, 81 plates. London, 1886-1887.

1851. Woodward, S. P. A Manual of the Mollusca; Recent and Fossil Shells. 1 vol., 12mo, 25 plates and many woodcuts. London, 1857.
Later edition by R. Tate.

1889. Yates, L. G. Stray Notes on the Geology of the Channel Islands. The Mollusca of the Channel Islands of California. Insular Floras. *9th Ann. Rept. Cal. St. Min.*, 1889.

EXPLANATION OF PLATE I.

(ALL FIGURES MAGNIFIED.)

Fig. 1.	*Turbonilla (Lancea) pentalopha* Dall & Bartsch. Type specimen. Longitude 8.5 mm.; ×6.	274
Fig. 1*a*.	Same. Nuclear whorls more enlarged.	274
Fig. 2.	*Turbonilla (Pyrgolampros) gibbosa* Carpenter. Longitude 5.6 mm.; ×9.3.	279
Fig. 2*a*.	Same. Nuclear whorls more enlarged.	279
Fig. 3.	*Odostomia (Oscilla) æquisculpta* Carpenter. Type specimen, not fully mature. Longitude 2 mm.; ×13.	284
Fig. 3*a*.	Same. Nuclear whorls more enlarged.	284
Fig. 4.	*Turbonilla (Pyrgiscus) auricoma* Dall & Bartsch. Type specimen. Longitude 7.2 mm.; ×6.2.	274
Fig. 4*a*.	Same. Nuclear whorls more enlarged.	274
Fig. 5.	*Turbonilla (Pyrgolampros) lowei* Dall & Bartsch. Type specimen. Longitude 7.2 mm.; ×6.2.	278
Fig. 5*a*.	Same. Nuclear whorls more enlarged.	278
Fig. 6.	*Odostomia (Oscilla) grammatospira* Dall & Bartsch. Type specimens. Longitude 5.3 mm.; ×10.	285
Fig. 6*a*.	Same. Nuclear whorls more enlarged.	285
Fig. 7.	*Turbonilla (Pyrgolampros) arnoldi* Dall & Bartsch. Type specimen. Longitude 7.6 mm.; ×6.2.	279
Fig. 8.	*Odostomia (Chrysallida) diegensis* Dall & Bartsch. Type specimen; the lower right-hand portion of the aperture defective. Longitude 4 mm.; ×11.	284
Fig. 9.	*Turbonilla (Pyrgolampros) adleri* Dall & Bartsch. Type specimen; the apex defective. Longitude 9.3 mm.; ×5.	280
Fig. 10.	*Turbonilla (Strioturbonilla) torquata* var. *stylina* Carpenter. Longitude 8 mm.; ×7.25.	272
Fig. 10*a*.	Same. Nuclear whorls more enlarged.	272
Fig. 11.	*Odostomia (Amaura) nuciformis* var. *avellana* Carpenter. Type specimen. Longitude 9.1 mm.; ×5.	283
Fig. 12.	*Odostomia (Evalea) stearnsii* Dall & Bartsch. Type specimen. Longitude 5.2 mm.; ×9.2.	282
Fig. 13.	*Odostomia (Amaura) pupiformis* Carpenter. Type specimen. Longitude 6.5 mm.; ×7.	283
Fig. 14.	*Odostomia tenuis* Carpenter. Longitude 5.7 mm.; ×8.	281
Fig. 15.	*Odostomia (Evalea) gouldii* Carpenter. Longitude 5 mm.; ×9.	282

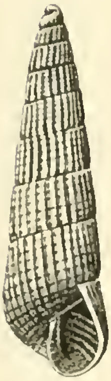
1 a

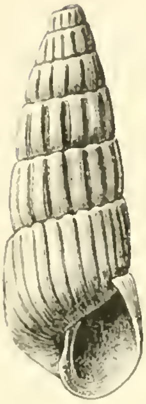
2 a

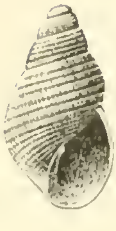
3 a

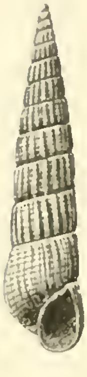
4 a

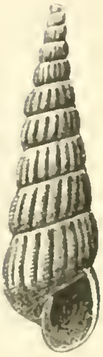
5 a

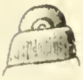

1

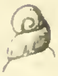

2

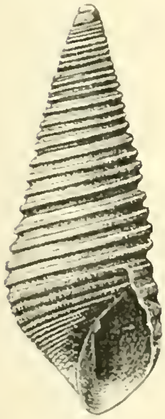

3

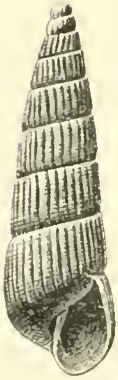

4

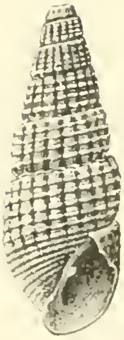

5


6 a

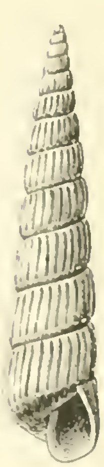

10 a

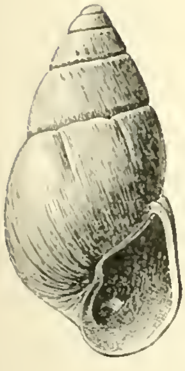

6

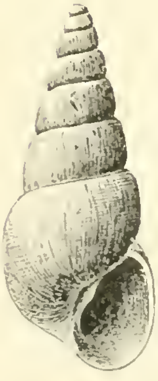

7

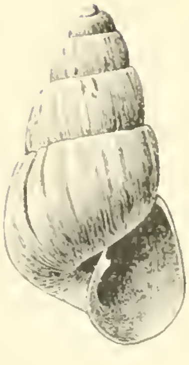

8

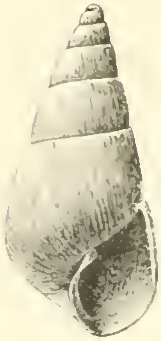
9

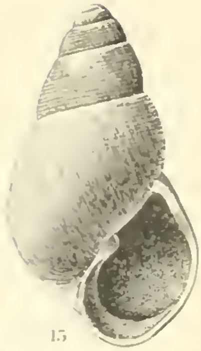

10


11


12


13


14


15

EXPLANATION OF PLATE II.

(ALL FIGURES MAGNIFIED.)

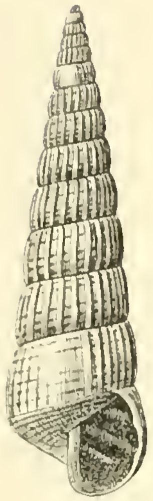
Fig.	1.	*Turbonilla (Lancea) tridentata* CARPENTER. Longitude 12.8 mm.; ×5.	273
Fig.	1*a*.	Same Nuclear whorls more enlarged.	273
Fig.	2.	*Turbonilla (Pyrgiscus) subcuspidata* CARPENTER. Type specimen. Longitude 6 mm.; ×9.	277
Fig.	2*a*.	Same. Nuclear whorls more enlarged.	277
Fig.	3.	*Turbonilla (Pyrgolampros) lowei* var. *pedroana* DALL & BARTSCH. Type specimen. Longitude 5.5 mm.; ×10.	279
Fig.	3*a*.	Same. Nuclear whorls more enlarged.	279
Fig.	4.	*Turbonilla torquata* GOULD. Longitude 10.6 mm.; ×6.	271
Fig.	4*a*.	Same. Nuclear whorls more enlarged.	271
Fig.	5.	*Turbonilla stearnsii* DALL & BARTSCH. Type specimen. Longitude 9.2 mm.; ×6.7.	271
Fig.	5*a*.	Same. Nuclear whorls more enlarged.	271
Fig.	6.	*Turbonilla (Pyrgiscus) crebrifilata* CARPENTER. Longitude 5.4 mm.; ×10.7.	276
Fig.	6*a*.	Same. Nuclear whorls more enlarged.	276
Fig.	7.	*Turbonilla (Pyrgiscus) tenuicula* GOULD. Longitude 6.1 mm.; ×9.	275
Fig.	7*a*.	Same. Nuclear whorls more enlarged.	275
Fig.	8.	*Turbonilla (Pyrgisculus) laminata* CARPENTER. Longitude 6.8 mm.; ×9.	277
Fig.	8*a*.	Same. Nuclear whorls more enlarged.	277

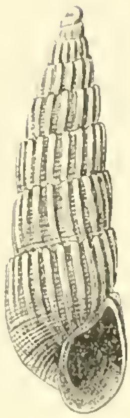
1 a

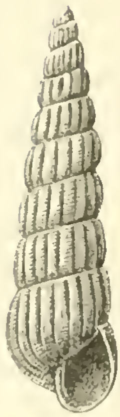
2 a

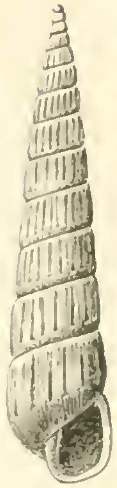
3 a

4 a


1


2


3

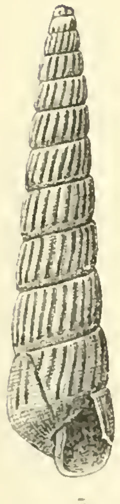

4

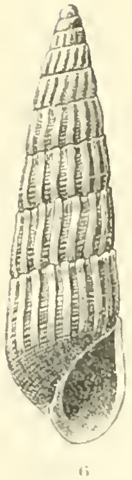
5 a

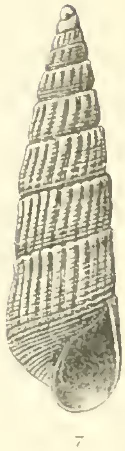
6 a

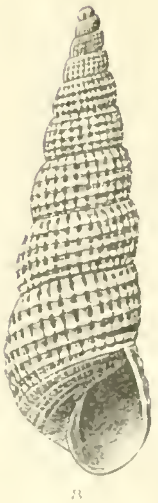
7 a

8 a


5

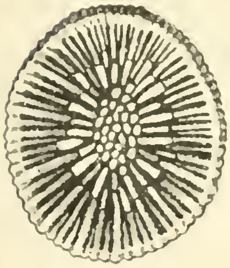

6

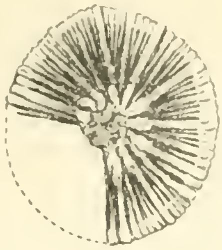

7

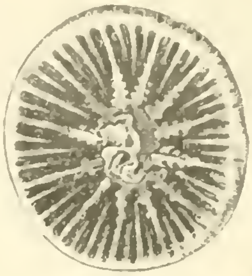

8

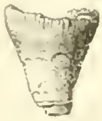
EXPLANATION OF PLATE III.

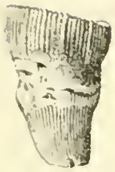
Fig. 1.	*Paracyathus pedroensis* VAUGHAN. View of calice. Greater diameter 12 mm.; ×2.8.	88
Fig. 1*a*.	Same. Upright view of corallum. Height 18 mm.; ×1.2.	88
Fig. 2.	*Caryophyllia californica* VAUGHAN. View of calice. Greater diameter 11.5 mm.; ×2.7.	87
Fig. 2*a*.	Same. Upright view of corallum. Height 13 mm.; ×1.2.	87
Fig. 3.	*Caryophyllia pedroensis* VAUGHAN. View of calice. Greater diameter 13.5 mm.; ×2.6	87
Fig. 3*a*.	Same. Upright view of corallum. Height 25.5 mm.; ×1.2.	87
Fig. 4.	*Caryophyllia arnoldi* VAUGHAN. Upright view of corallum. Height 16.5 mm.; ×2.5.	86
Fig. 4*a*.	Same. View of calice. Greater diameter 16 mm.; ×2.5.	86
Fig. 5.	*Turbonilla (Pyrgiscus) latifundia* DALL & BARTSCH. Type specimen. Longitude 5.8 mm.; ×7.4.	275
Fig. 5*a*.	Same. Nuclear whorls more magnified.	275

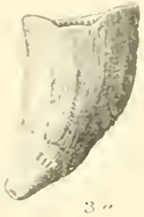

1

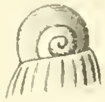

2

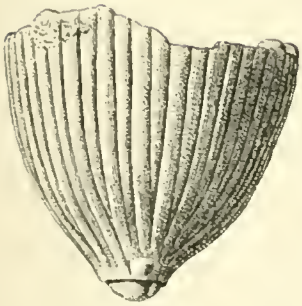

3

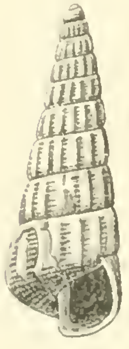

2 a

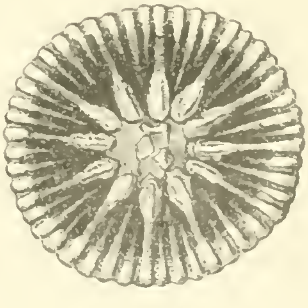

1 a


3 a


5 a


4


5


4 a

EXPLANATION OF PLATE IV.

Fig. 1. *Nassa cerritensis*, sp. nov. Upper San Pedro series, Los Cerritos. Type specimen. Longitude 31 mm.; ×1.3. 231

Fig. 2. *Volvula cylindrica* Carpenter. Lower San Pedro series, Deadman Island. Longitude 7 mm.; ×2. 191

Fig. 3. *Nassa californiana* Conrad. Upper San Pedro series, San Pedro. Longitude 38 mm.; ×3. 231

Fig. 4. *Bittium californicum* Dall & Bartsch. Lower San Pedro series, San Pedro. Longitude 5.6 mm.; ×4. 291

Fig. 5. *Siphonalia kellettii* Forbes. Upper San Pedro series, San Pedro. Longitude 112 mm.; natural size. 229

Fig. 6. *Nassa versicolor* var. *hooveri*, var. nov. Upper San Pedro series, San Pedro. Type specimen. Longitude 14 mm.; ×2.7. 362

Fig. 7. *Fusus rugosus* Trask. Lower San Pedro series, Deadman Island. Longitude 50 mm.; ×1.3. 226

Fig. 8. *Scila assimilata* C. B. Adams. Lower San Pedro series, San Pedro. Longitude 10 mm.; ×4. 290

Fig. 9. *Marginella (Volvarina) varia* Sowerby. Lower San Pedro series, Deadman Island. Longitude 9.2 mm.; ×2.6. 222

Fig. 10. *Mitromorpha intermedia*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 9.6 mm.; ×4. 223

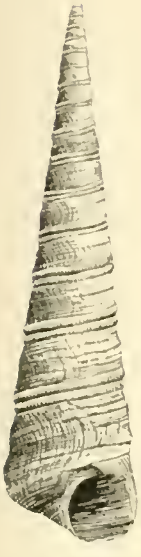
Fig. 11. *Bittium rugatum* Carpenter. Upper San Pedro series, San Pedro. Longitude 13 mm ; ×3.1. 295

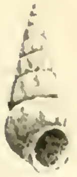
Fig. 12. *Rissoa acutelirata* Carpenter. Upper San Pedro series, San Pedro. Longitude 2.1 mm.; ×6.7. 305

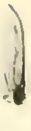
Fig. 13. *Turritella jewettii* Carpenter. Pliocene, Deadman Island. Longitude 69 mm.; natural size. 300

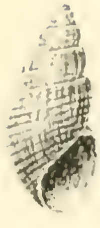
Fig. 14. *Odostomia (Ivara) terricula* (Carpenter) D. & B. Lower San Pedro series, Deadman Island. Longitude 4 mm.; ×6.7. 285

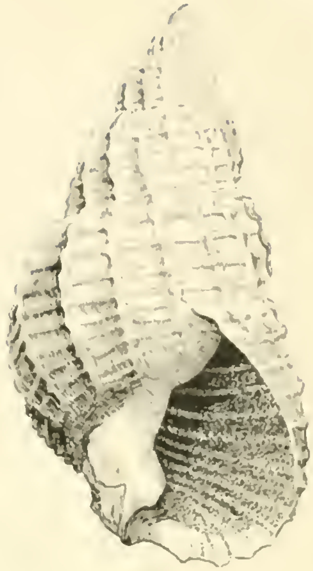
Fig. 15. *Fusus barbarensis* Trask. Pliocene, Deadman Island. Longitude 50 mm.; ×1.5. 224

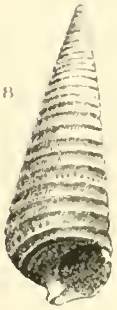

13

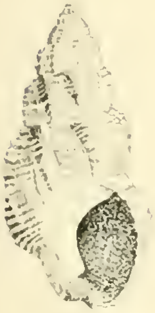

4

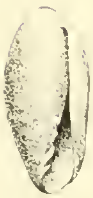

2

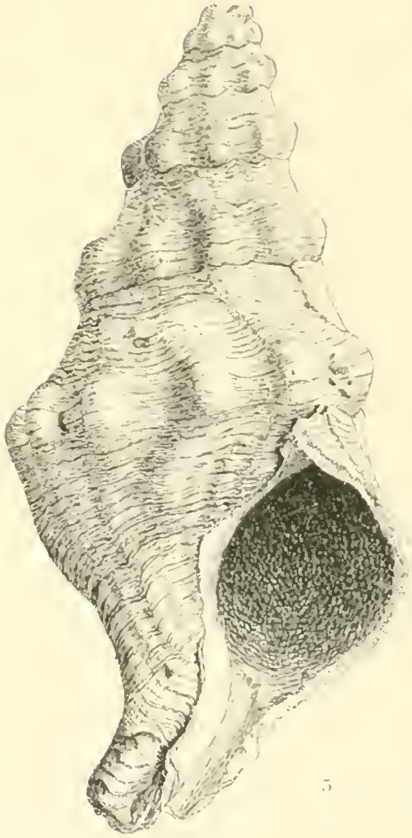

14

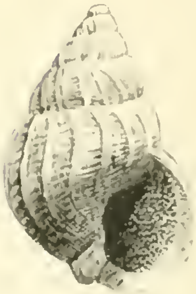

3

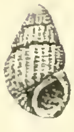

8

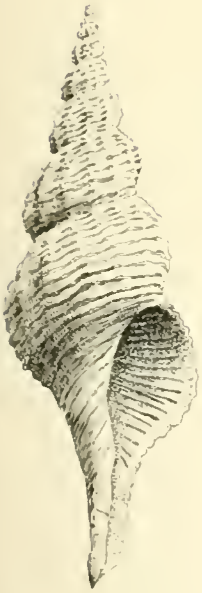

1

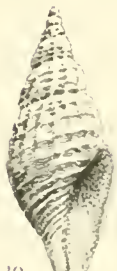

9

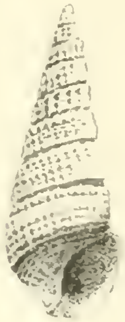

5

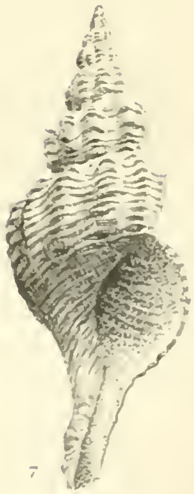

6


12


15

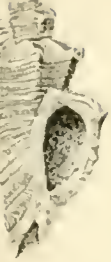

10

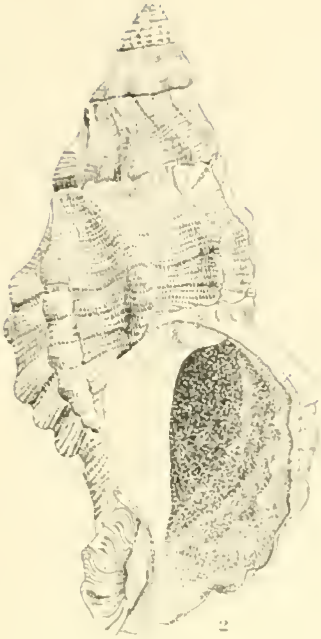

11

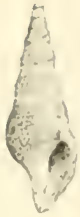

7

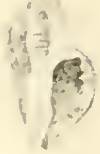
EXPLANATION OF PLATE V.

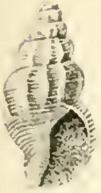
Fig. 1.	*Ocinebra barbarensis* Gabb. Lower San Pedro series, Deadman Island. Longitude 19 mm.; ×2.	254
Fig. 2.	*Ocinebra poulsoni* Nuttall. Upper San Pedro series, San Pedro. Longitude 31 mm.; ×2.7.	260
Fig. 3.	*Scala tincta* Carpenter. Upper San Pedro series, San Pedro. Longitude 19 mm.; ×2.	265
Fig. 4.	*Scala indianorum* Carpenter. Upper San Pedro series, San Pedro. Longitude 21 mm.; ×2.	264
Fig. 5.	*Ocinebra lurida* var. *cerritensis*, var. nov. Upper San Pedro series, Crawfish George's. Type specimen. Longitude 17 mm.; ×1.3.	258
Fig. 6.	*Columbella (Æsopus) chrysalloidea* Carpenter. Upper San Pedro series, San Pedro. Longitude 11 mm.; ×2.	237
Fig. 7.	*Pleurotoma (Borsonia) bartschi*, sp. nov. Lower San Pedro series, Deadman Island. Short variety. Longitude 14 mm.; ×1.3.	200
Fig. 8.	*Drillia hemphilli* Stearns. Upper San Pedro series, San Pedro. Longitude 16 mm.; ×2.5.	204
Fig. 9.	*Ocinebra keepi*, sp. nov. Upper San Pedro series, Deadman Island. Type specimen. Longitude 35 mm.; ×2.	256
Fig. 10.	*Drillia inermis* Hinds. Upper San Pedro series, San Pedro. Longitude 22 mm.; ×1.25.	205
Fig. 11.	*Amphissa ventricosa*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 13 mm.; ×2.	242
Fig. 12.	*Ocinebra lurida* var. *aspera* Baird. Upper San Pedro series, San Pedro. Longitude 28 mm.; ×2.	257
Fig. 13.	*Margarita optabilis* var. *nodosa*, var. nov. Lower San Pedro series, San Pedro. Type specimen, tilted back. Altitude 6.9 mm.; ×4.	332
Fig. 14.	*Margarita optabilis* var. *knechti*, var. nov. Lower San Pedro series, San Pedro. Type specimen, tilted back. Altitude 8 mm.; ×3.	332
Fig. 15.	*Ocinebra micheli* Ford. Upper San Pedro series, Crawfish George's. Longitude 16 mm.; ×2.5.	259
Fig. 16.	*Margarita parcipicta* var. *pedroana*, var. nov. Lower San Pedro series, San Pedro. Type specimen, tilted back. Altitude 5.5 mm.; ×4.	333

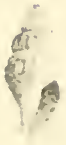

1

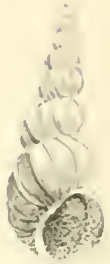

2

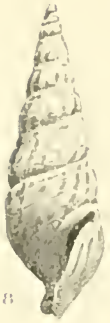

10

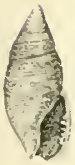

5

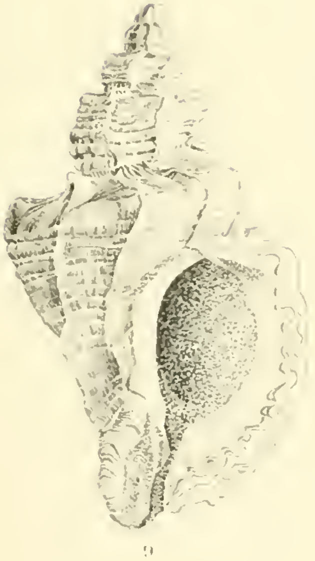

11

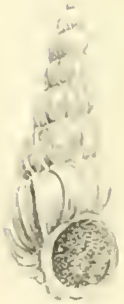

7

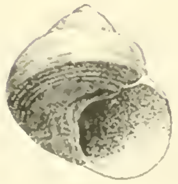

3

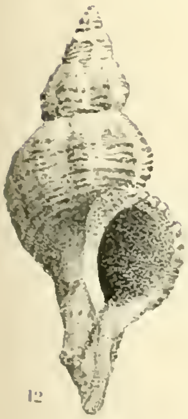

8

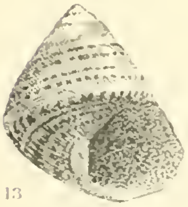

6

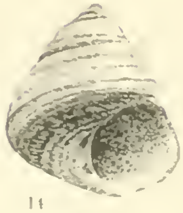

9

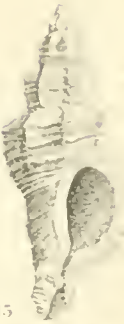

4


16


12


13


14


15

EXPLANATION OF PLATE VI.

Fig. 1. *Tritonium (Priene) oregonensis* Redfield. Pliocene, Deadman Island. Longitude 102 mm.; natural size. 286

Fig. 2. *Pleurotoma (Borsonia) dalli*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 23 mm.; × 2. 201

Fig. 3. *Mangilia interfossa* var. *pedroana*, var. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 6 mm.; ×5. 213

Fig. 4. *Trophon (Boreotrophon) stuarti* Smith. Pliocene, Deadman Island. Longitude 30 mm.; ×2. 252

Fig. 5. *Trophon (Boreotrophon) orpheus* var. *præcursor*, var. nov. Pliocene, Deadman Island. Type specimen. Longitude 15 mm.; ×2.7. 253

Fig. 6. *Trophon (Boreotrophon) cerritensis*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 32 mm.; ×2. 249

Fig. 7. *Columbella (Æsopus) oldroydi*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 8.5 mm.; ×2.6. 238

Fig. 8. *Trophon (Boreotrophon) gracilis* Perry. Pliocene, Deadman Island. Longitude 26 mm.; × 2. 250

Fig. 9. *Trophon (Boreotrophon) multicostatus* Eschscholtz. Lower San Pedro series, Deadman Island. Longitude 10 mm.; ×2.6. 251

Fig. 10. *Trophon (Boreotrophon) scalariformis* Gould. Lower San Pedro series, Deadman Island. Longitude 15.5 mm.; ×2.6. 252

Fig. 11. *Bittium williamsoni*, sp. nov. Upper San Pedro series, San Pedro. Type specimen. Longitude 2.9 mm.; ×7.2. 295

Fig. 12. *Trophon (Boreotrophon) pedroana*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 12 mm.; ×3.3. 251

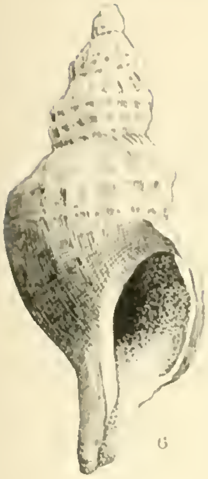
Fig. 13. *Pleurotoma (Spirotropsis) smithi*, sp. nov. Pliocene, Deadman Island. Type specimen. Longitude 36 mm.; ×1.5. 216

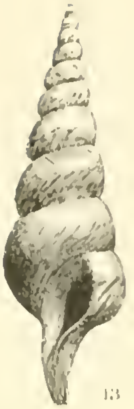
Fig. 14. *Bittium (Styliferina) tenuisculpta* Carpenter. Lower San Pedro series, Deadman Island. Longitude 6.1 mm.; ×4. 296

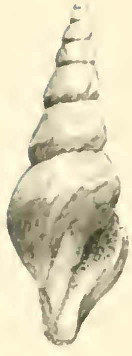
Fig. 15. *Mangilia interlirata* Stearns. Lower San Pedro series, Deadman Island. Longitude 9.1 mm.; ×3. 213

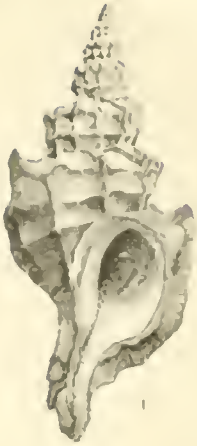
Fig. 16. *Mangilia oldroydi*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 16.1 mm.; ×2.5. 213

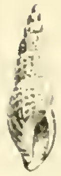
Fig. 17. *Mangilia sculpturata* Dall. Pliocene, Deadman Island. Longitude 11 mm.; ×3. 214

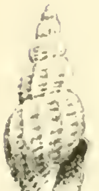

6

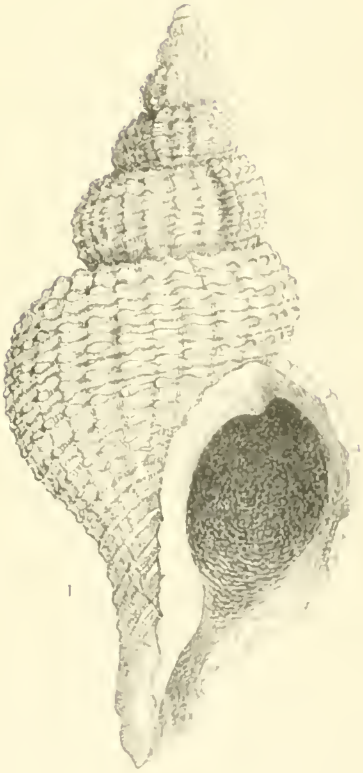

13

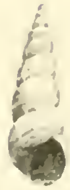

2


4


7

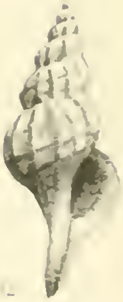

3

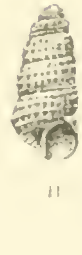

1

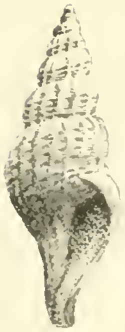

14

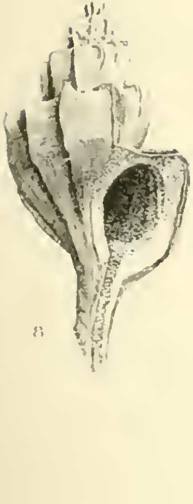
15

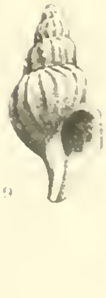
5

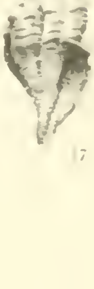

12

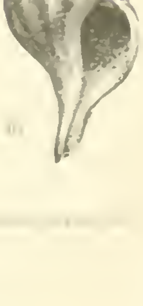

11


16


8


9


17


10

EXPLANATION OF PLATE VII.

Fig. 1. *Murex (Chicoreus) leeanus* Dall. Upper San Pedro series, San Pedro. Longitude 55 mm.; ×1.3. 243

Fig. 2. *Solariella peramabilis* Carpenter. Pliocene, Deadman Island. Altitude 14 mm.; ×1.5. 335

Fig. 3. *Pleurotoma (Dolichotoma) cooperi*, sp. nov. Upper San Pedro series, San Pedro. Longitude 64 mm; natural size. 203

Fig. 4. *Admete gracilior* Carpenter. Lower San Pedro series, Deadman Island. Longitude 10.5 mm.; ×3.3. 219

Fig. 5. *Cancellaria tritonidea* Gabb. Upper San Pedro series, San Pedro. Longitude 90 mm.; natural size. 218

Fig. 6. *Chrysodomus tabulatus* Baird Pliocene, Deadman Island. Longitude 80 mm.; natural size. 228

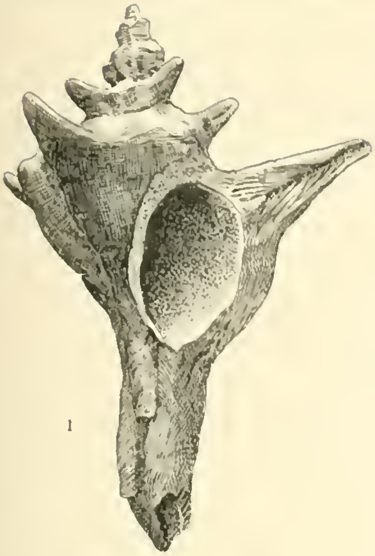
Fig. 7. *Chrysodomus rectirostris* Carpenter. Lower San Pedro series, Deadman Island. Longitude 28 mm.; ×2. 228

Fig. 8. *Cancellaria cooperi* Gabb. Upper San Pedro series, San Pedro. Longitude 80 mm.; natural size. 217

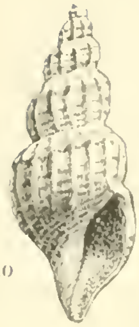
Fig. 9. *Mangilia angulata* Carpenter. Lower San Pedro series, Deadman Island. Longitude 8 mm; ×3.6. 212

Fig. 10. *Bela fidicula* Gould. Lower San Pedro series, Deadman Island. Longitude 11 mm.; ×4. 209

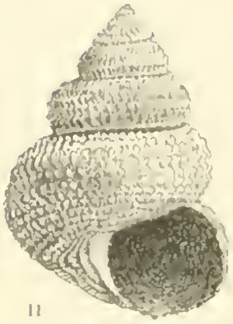
Fig. 11. *Solariella cidaris* Carpenter. Pliocene, Deadman Island. Altitude 42 mm.; natural size. 334



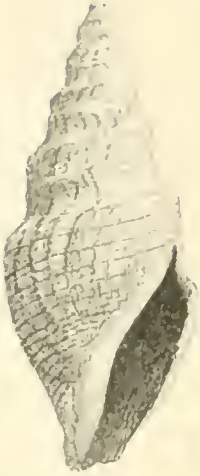
1

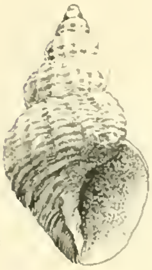


10

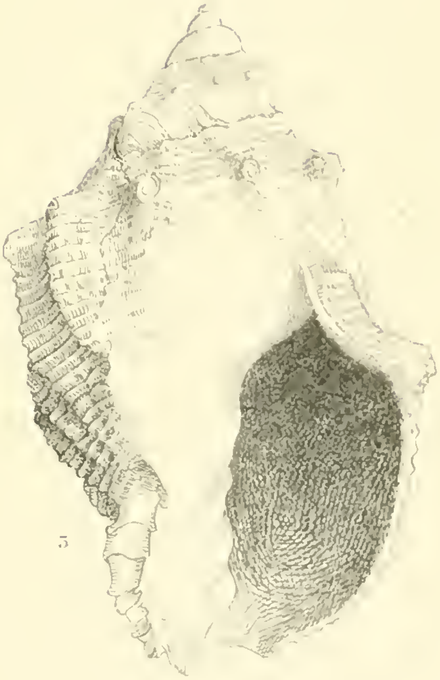


11

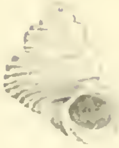




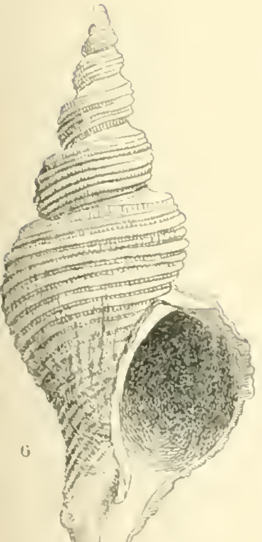
4



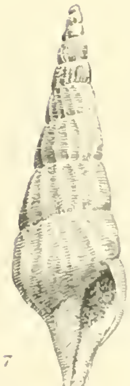
5



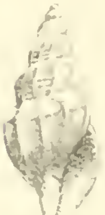
2



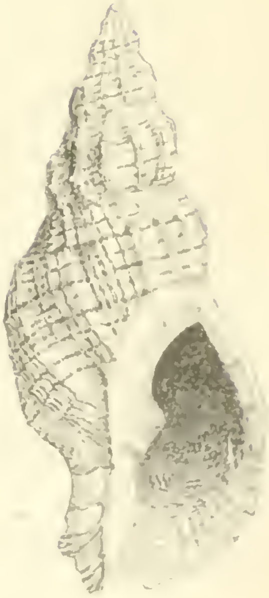
6



7

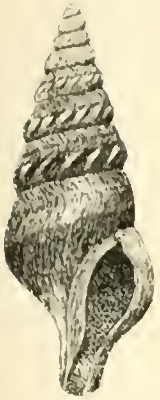


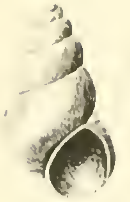
9

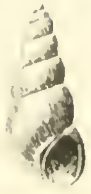


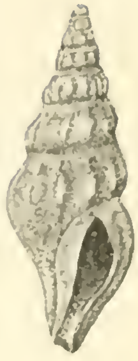
EXPLANATION OF PLATE VIII.

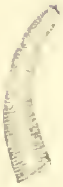
Fig. 1.	*Mangilia painei*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 12.5 mm ; ×3.4.	214
Fig. 2.	*Paludestrina curta*, sp. nov. Lower San Pedro series, San Pedro. Type specimen. Longitude 3.8 mm.; ×7.	305
Fig. 3.	*Paludestrina stokesi*, sp nov. Lower San Pedro series, San Pedro. Type specimen. Longitude 4.6 mm.; ×5.4.	305
Fig. 4.	*Dentalium indianorum* Carpenter. Lower San Pedro series, Deadman Island. Longitude 38 mm.; natural size.	186
Fig. 5.	*Drillia renaudi*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 16 mm.; ×3.	208
Fig. 6.	*Cæcum californicum* Dall. Lower San Pedro series, Deadman Island. Longitude 2.9 mm.; ×5.8.	297
Fig. 7.	*Drillia merriami*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 14 mm.; ×3.2.	207
Fig. 8.	*Bulla quoyi* Gray. Upper San Pedro series, San Pedro. A young specimen. Longitude 8 mm.; ×3.	193
Fig. 9.	*Eupleura muriciformis* var. *curta*, var. nov. Upper San Pedro series, San Pedro. Type specimen. Longitude 15 mm.; ×3.2.	249
Fig. 10.	*Cæcum crebricinctum* Carpenter. Lower San Pedro series, San Pedro Bluff. Longitude 5.5 mm.; ×6.	298
Fig. 11.	*Lacuna solidula* (Lovén) Carpenter. Upper San Pedro series, San Pedro. A somewhat decorticated specimen. Longitude 10 mm.; ×2.5.	303
Fig. 12.	*Dentalium pseudohexagonum* Dall. Lower San Pedro series, Deadman Island. Longitude 15.5 mm.; ×3.	186
Fig. 12*a*.	Sectional view of same; ×3.	186
Fig. 13.	*Drillia pudica* Hinds. Upper San Pedro series, San Pedro. Longitude 11 mm ; ×3.5.	208
Fig. 14.	*Bela sanctæ-monicæ*, sp. nov. Lower San Pedro series (Pleistocene), Port Los Angeles. Type specimen. Longitude 12 mm.; ×3.	210
Fig. 15.	*Cadulus nitentior* Carpenter. Lower San Pedro series, Deadman Island. Longitude 10 mm.; ×3.3	187
Fig. 16.	*Cæcum magnum* Stearns. Lower San Pedro series, Deadman Island. Longitude 4.7 mm.; ×5.3.	298
Fig. 17.	*Drillia johnsoni*, sp. nov. Upper San Pedro series, San Pedro. Type specimen, apex broken off. Longitude 29 mm.; ×2.	206
Fig. 18.	*Haminea virescens* Sowerby. Upper San Pedro series, San Pedro. Longitude 7 mm.; ×3.25.	194


5

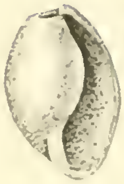

2


3


7

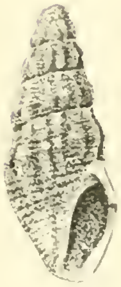

16

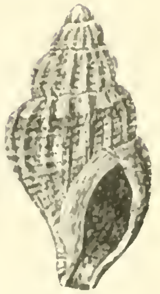
6


8

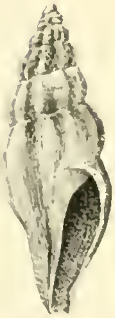
10

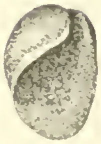
12

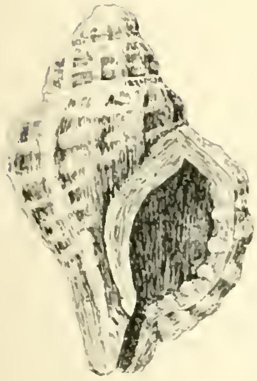

13


14

12 a

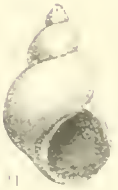

1

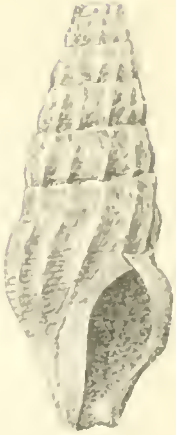

18


9

4

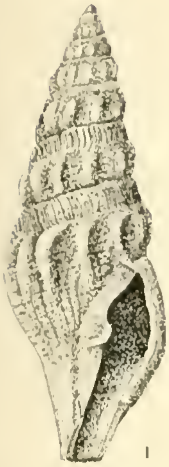
15


11

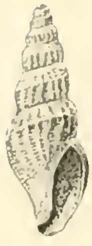

17

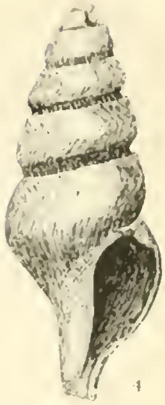
EXPLANATION OF PLATE IX.

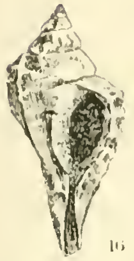
Fig. 1.	*Pleurotoma (Borsonia) bartschi*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 18.5 mm.; ×3.4.	200
Fig. 2.	*Bittium quadrifilatum* Carpenter. Lower San Pedro series, Deadman Island. Longitude 10 mm.; ×3.	292
Fig. 3.	*Mangilia striosa* C. B. Adams. Upper San Pedro series, Los Cerritos. Longitude 9.4 mm.; ×3.	215
Fig. 4.	*Pleurotoma (Leucosyrinx) pedroana*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 17 mm.; ×3.	202
Fig. 5.	*Mangilia hooveri*, sp. nov. Upper San Pedro series, San Pedro. Type specimen. Longitude 11 mm.; ×3.	212
Fig. 6.	*Actæon (Rictaxis) punctocœlata* Carpenter. Upper San Pedro series, San Pedro. Longitude 5.9 mm.; ×3.	189
Fig. 7.	*Mangilia (Taranis) strongi*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 12 mm.; ×3.5.	215
Fig. 8.	*Columbella (Anachis) minima*, sp. nov. Upper San Pedro series, San Pedro. Type specimen. Longitude 5.5 mm.; ×3.	237
Fig. 9.	*Eulima hastata* Sowerby. Upper San Pedro series, San Pedro. Longitude 10 mm.; ×3.4.	268
Fig. 10.	*Mangilia (Cythara) branneri*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 10 mm.; ×3.2.	211
Fig. 11.	*Ocinebra lurida* var. *cancellina* Philippi. Upper San Pedro series, San Pedro. Longitude 21 mm.; ×2.	257
Fig. 12.	*Eulima micans* Carpenter. Lower San Pedro series, Deadman Island. Longitude 12 mm.; ×3.5.	269
Fig. 13.	*Planorbis tumidus* Pfeiffer. Upper San Pedro series, San Pedro. Maximum diameter 12.7 mm.; ×3.	195
Fig. 14.	*Planorbis vermicularis* Gould. Upper San Pedro series, San Pedro. Maximum diameter 11.5 mm.; ×3.	195
Fig. 15.	*Eulima falcata* Carpenter. Lower San Pedro series, Deadman Island. Longitude 7 mm.; ×3.	268
Fig. 16.	*Eupleura muriciformis* Broderip. Upper San Pedro series, San Pedro. Longitude 33 mm.; natural size.	248
Fig. 17	*Scala bellastriata* Carpenter. Figure of living shell from San Pedro. Longitude 18 mm.; ×2.	263

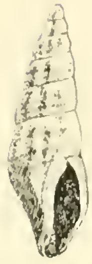

1

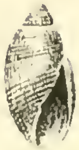
2

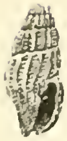

3


4

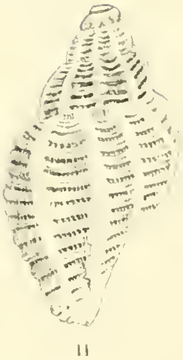

16

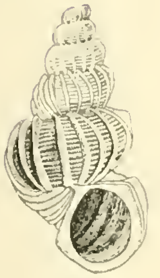

5

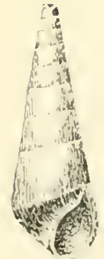

6

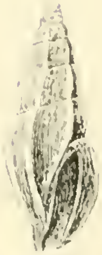

8

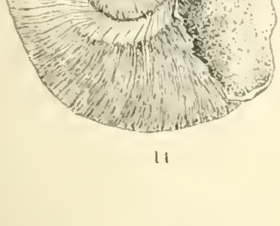
7

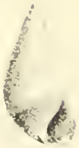

11


17

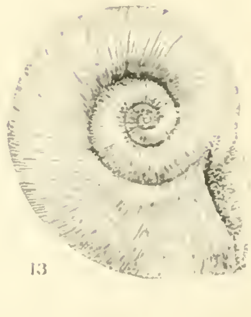

9


10


14


15

12


13

[illegible] Lith. [illegible] & [illegible] S.E.

EXPLANATION OF PLATE X.

Fig. 1. *Pleurotoma (Borsonia) hooveri*, sp. nov. Lower San Pedro series, Deadman Island. Type specimen. 12.7 mm.; ×3. 201

Fig. 2. *Phorcus pulligo* MARTYN. Upper San Pedro series, Crawfish George's. Specimen slightly tilted back. Altitude 17.5 mm.; natural size. 328

Fig. 3. *Tornatina culcitella* GOULD. Lower San Pedro series, Deadman Island. Longitude 11 mm.; ×3.2. 190

Fig. 4. *Columbella solidula* var. *præcursor*, var. nov. Upper San Pedro series, San Pedro. Type specimen. Longitude 14.4 mm.; ×3.5. 236

Fig. 5. *Tornatina cerealis* GOULD. Lower San Pedro series, San Pedro. Longitude 4.5 mm.; ×5.5. 189

Fig. 6. *Actæon traskii* STEARNS. Upper San Pedro series, San Pedro. Longitude 14 mm.; ×3. 188

Fig. 7. *Columbella (Astyris) tuberosa* CARPENTER. Upper San Pedro series, San Pedro. Longitude 6.5 mm.; ×3. 240

Fig. 8. *Columbella (Astyris) gausapata* GOULD. Upper San Pedro series, San Pedro. Longitude 10 mm.; ×3. 239

Fig. 9. *Columbella (Astyris) californiana* GASKOIN. Lower San Pedro series, Deadman Island. Longitude 10 mm.; ×3. 238

Fig. 10. *Columbella (Astyris) gausapata* var. *carinata* HINDS. Upper San Pedro series, San Pedro. Longitude 7.7 mm.; ×3. 240

Fig. 11. *Tornatina eximia* BAIRD. Pliocene, Deadman Island. Longitude 12.5 mm.; ×3. 190

Fig. 12. *Polynices (Neverita) recluziana* PETIT. Upper San Pedro series, San Pedro. Typical shape. Altitude 17.5 mm.; natural size. 314

Fig. 13. *Natica (Cryptonatica) clausa* BRODERIP & SOWERBY. Pliocene, Deadman Island. Shouldered variety. Altitude 26 mm.; natural size. 313

Fig. 14. *Polynices (Lunatia) lewisii* GOULD. Upper San Pedro series, San Pedro. Longitude 75 mm.; ×0.66. 315

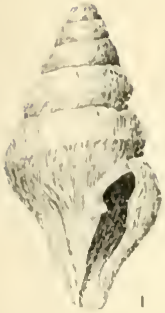
Fig. 15. *Margarita pupilla* GOULD. Pliocene, Deadman Island. Altitude 7.5 mm.; ×3. 333

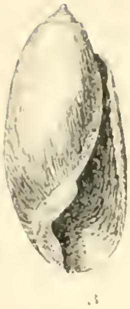
Fig. 16. *Delphinoidea coronadoensis*, sp. nov. Pleistocene, Spanish Bight, San Diego. Type specimen, view from above. Maximum diam. 2 mm.; ×5. 320

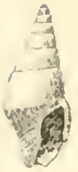
Fig. 17. Same specimen viewed from in front; ×5. 320

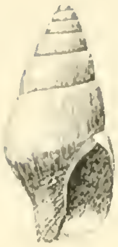
Fig. 18. *Cylichna alba* BROWN. Lower San Pedro series, Deadman Island. Longitude 12 mm.; ×1.5. 192

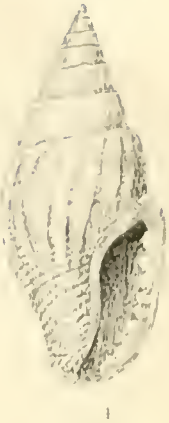
Fig. 19. *Chlorostoma montereyi* KIENER. Upper San Pedro series, Crawfish George's. Specimen slightly tilted back. Altitude 28 mm.; natural size. 326

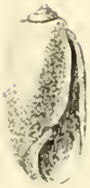

1

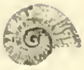

3

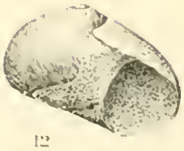

7

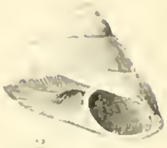

8


4

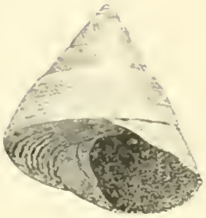

5

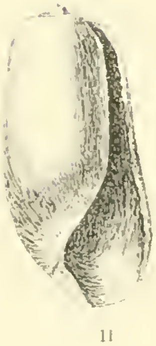

16

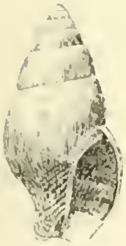

12

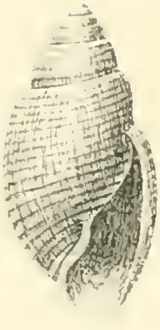

2

17

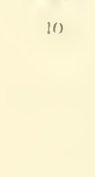

19

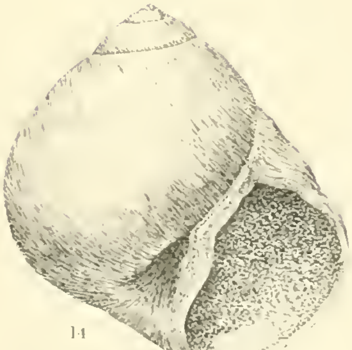

11

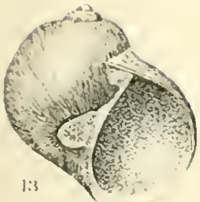

9

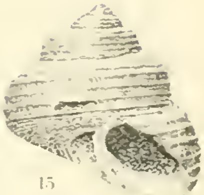

6

18


10


14


13


15

EXPLANATION OF PLATE XI.

Fig. 1. *Pecten (Plagioctenium) newsomi*, sp. nov. Upper San Pedro series, Los Cerritos. Type specimen, left valve. Altitude 26 mm.; ×1.4. 113

Fig. 1*a*. Same specimen. Outline, showing convexity of valve. ×1.4. 113

Fig. 2. *Pecten (Chlamys) hericeus* GOULD. Pliocene, Deadman Island. Exterior of left valve. Altitude 50 mm.; natural size. 110

Fig. 3. *Pecten (Plagioctenium) ventricosus* SOWERBY. Upper San Pedro series, San Pedro. Exterior of left valve. Altitude 36 mm.; ×1.3. 114

Fig. 3*a*. Same specimen. Outline, showing convexity of valve; ×1.3. 114

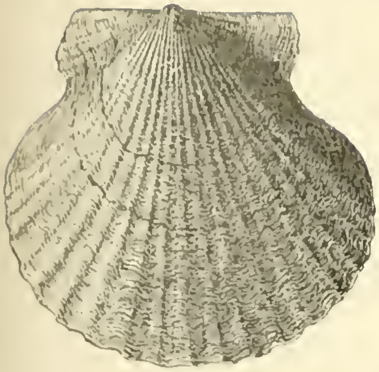
Fig. 4. *Pecten (Chlamys) hastatus* SOWERBY. Pliocene, Deadman Island. Left valve, exterior view. Altitude 38 mm.: ×1.3. 109

Fig. 4*a*. Same specimen. Outline, showing convexity of valve; ×1.3. 109

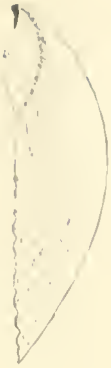
Fig. 5. *Pecten (Chlamys) hericeus* var. *strategus* DALL. Lower San Pedro series, Deadman Island. Exterior of right valve. Altitude 21 mm.; ×1.3. 110

Fig. 6. *Pecten (Plagioctenium) ventricosus* SOWERBY. Upper San Pedro series, San Pedro. Exterior of left valve. Altitude 56 mm.; natural size. 114

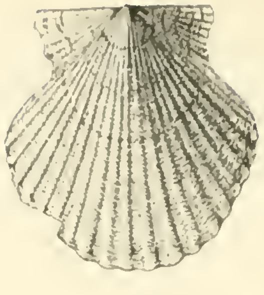
Fig. 6*a*. Same specimen. Outline, showing convexity of valve; natural size. 114



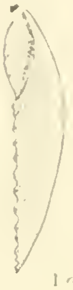
3



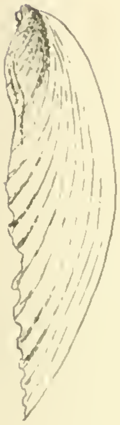
3 a



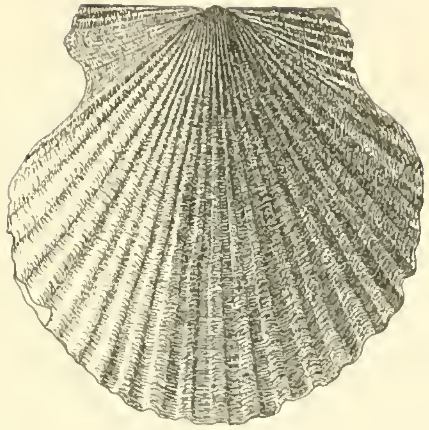
1



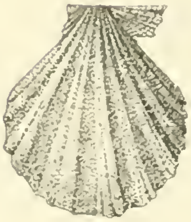
1 a



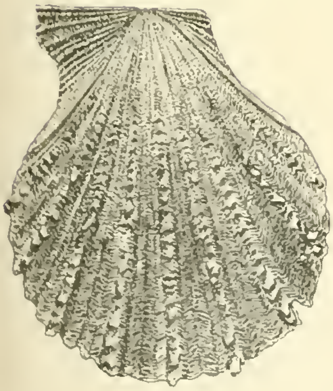
6 a



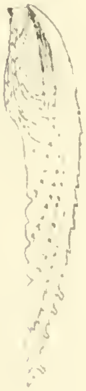
6



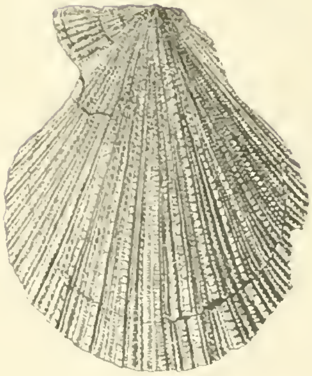
5



4



4 a

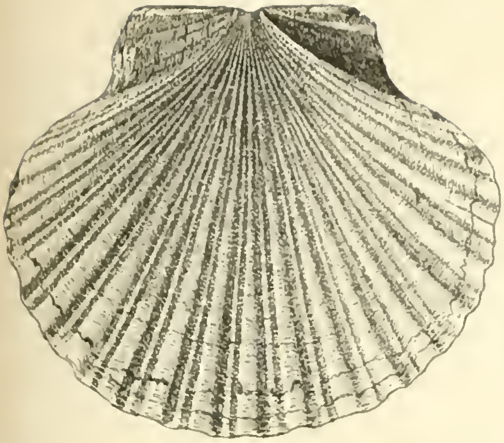


2

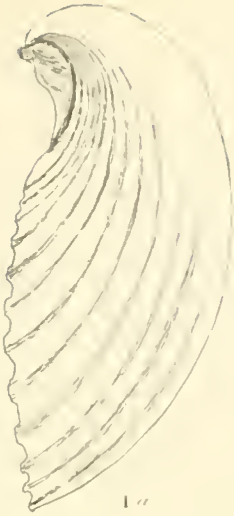
PHOTO-LITH BRITTON & REY S.F.

EXPLANATION OF PLATE XII.

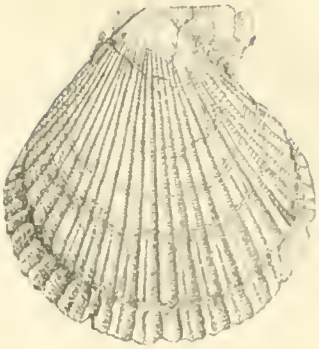
Fig. 1.	*Pecten (Pecten) dentatus* SOWERBY. Living shell from Gulf of California. Exterior of left or flat valve. Altitude 58 mm.; natural size.	104
Fig. 1*a*.	Same specimen. Outline, showing convexity of right valve; natural size.	104
Fig. 2.	*Pecten (Chlamys) latiauritus* CONRAD. Upper San Pedro series, San Pedro. Exterior of left valve. Altitude 23 mm.; ×1 3.	111
Fig. 2*a*.	Same specimen. Outline, showing convexity of same valve; ×1.3.	111
Fig. 3.	*Pecten (Pecten) stearnsii* DALL. Pliocene, San Diego. Exterior of left or flat valve. Altitude 65.5 mm.; natural size.	106
Fig. 4.	*Pecten (Chlamys) latiauritus* var. *monotimeris* CONRAD. Upper San Pedro series, San Pedro. Exterior of left valve. Altitude 20.5 mm.; ×1.3.	112
Fig. 4*a*.	Same specimen. Outline, showing convexity of same valve; ×1.3.	112
Fig. 5.	*Pecten (Pecten) diegensis* DALL. Living shell, Monterey. Outline, showing convexity of right valve (which is the same as the convexity of the right valve of *P. stearnsii*). Altitude 72 mm.; natural size.	106
Fig. 6.	*Pecten (Chlamys) jordani*, sp. nov. Pliocene, Deadman Island. Type specimen, exterior of right valve. Altitude 51 mm.; ×0.9.	111
Fig. 7.	Same specimen, exterior of left valve; ×0.9.	111
Fig. 8.	*Pecten (Chlamys) latiauritus* var. *fragilis*, var. nov. Upper San Pedro series, San Pedro. Type specimen, exterior of right valve. Altitude 25 mm.; ×1.3.	112



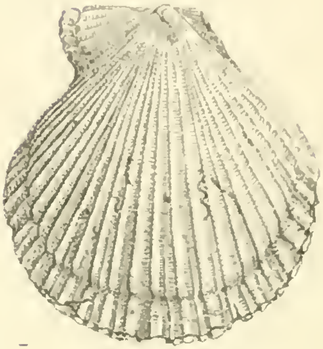
1



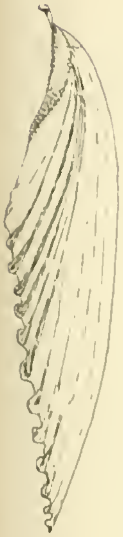
1 a



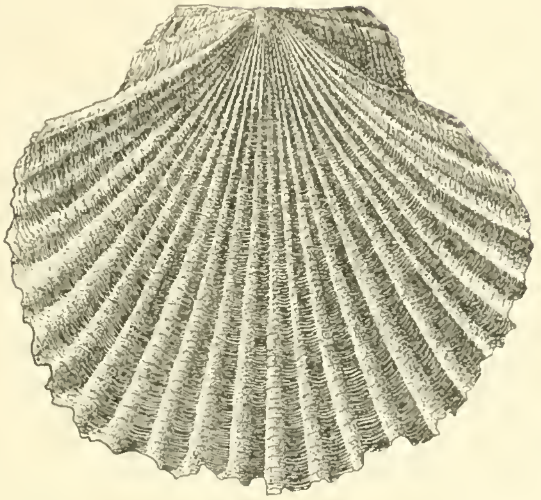
6



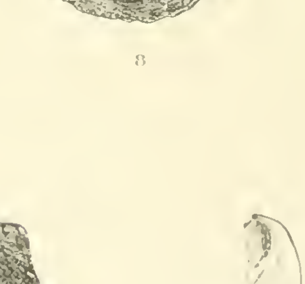
7



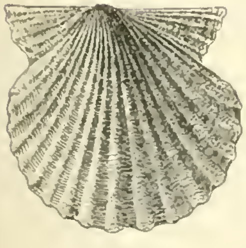
5



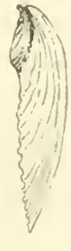
3



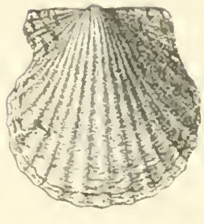
8



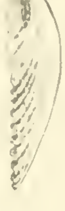
2



2 a



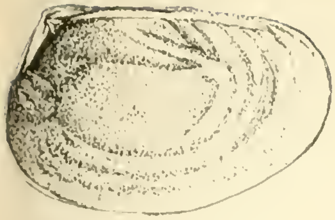
4



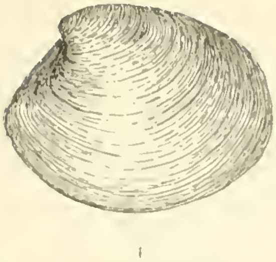
4 a

EXPLANATION OF PLATE XIII.

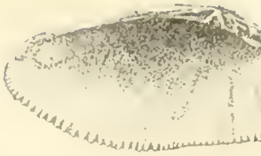
Fig. 1.	*Cooperella subdiaphana* Carpenter. Lower San Pedro series, Deadman Island. Interior, showing hinge. Longitude 12.5 mm.; ×5.	153
Fig. 2.	*Callista subdiaphana* var. *pedroana*, var. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 33 mm.; ×0.8.	144
Fig. 3.	*Aligena cerritensis*, sp. nov. Upper San Pedro series, Los Cerritos. Type specimen, view of interior. Longitude 10.9 mm.; ×3.	138
Fig. 4.	*Callista subdiaphana* Carpenter. Pliocene, Deadman Island. Longitude 45 mm.; ×0.8.	144
Fig. 5.	*Psephis tantilla* Gould. Lower San Pedro series, Deadman Island. View of interior. Longitude 6 mm.; ×4.	133
Fig. 6.	*Pecten (Patinopecten) caurinus* Gould. Pliocene, Deadman Island. Exterior of left valve. Altitude 122 mm.; ×0.8.	107
Fig. 7.	*Tellina (Moerella) salmonea* Carpenter. Lower San Pedro series, Deadman Island. Interior of right valve. Longitude 14 mm.; ×3.3.	157
Fig. 8.	*Donax lævigata* Deshayes. Upper San Pedro series, San Pedro. Interior view. Longitude 21 mm.; ×2.5.	170
Fig. 9.	*Donax californica* Conrad. Lower San Pedro series, Deadman Island. Interior view. Longitude 17 mm.; ×2.5.	170



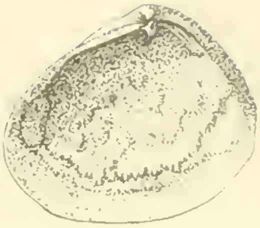
7



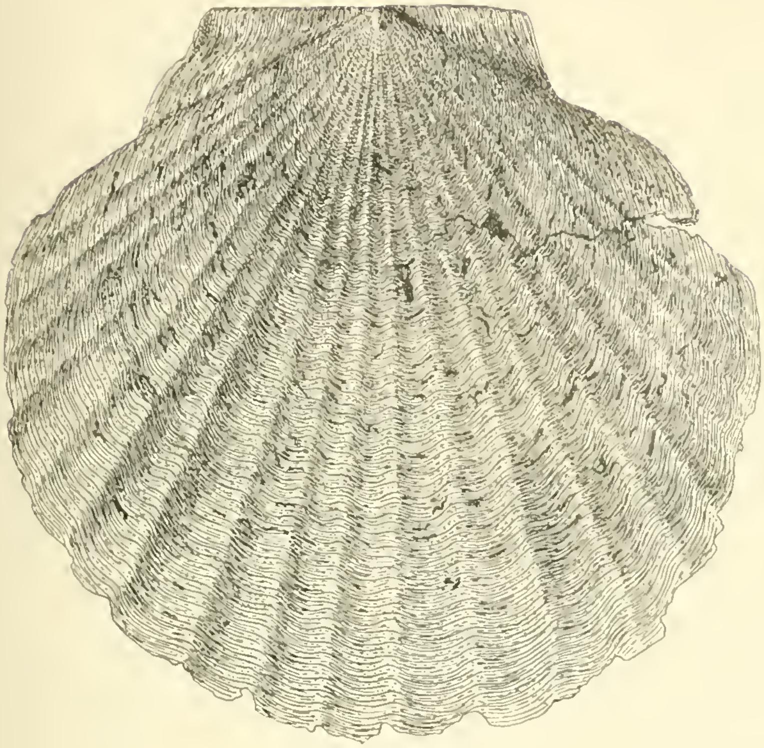
4



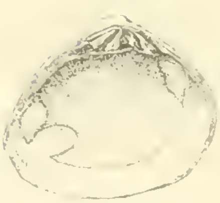
9



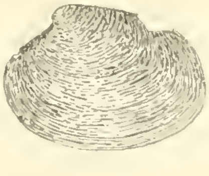
3



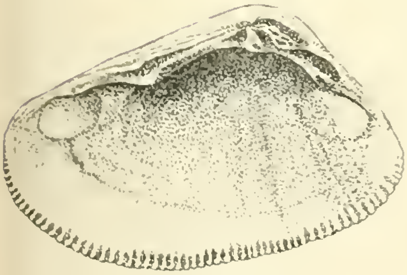
6



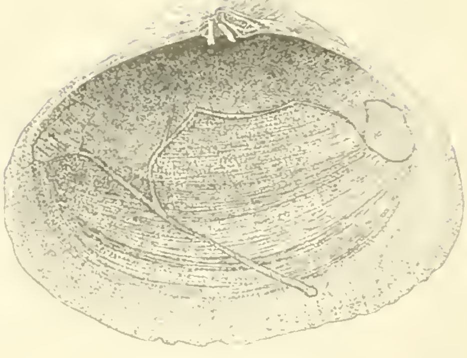
5



2



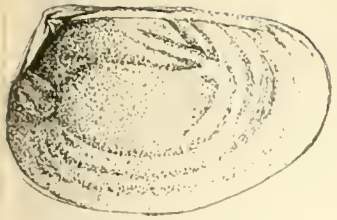
8

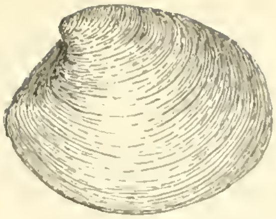


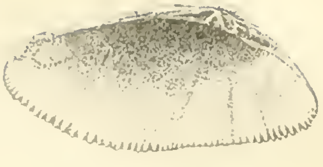
1

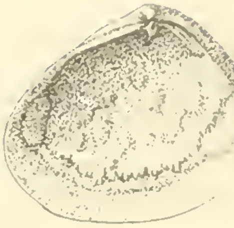
EXPLANATION OF PLATE XIII.

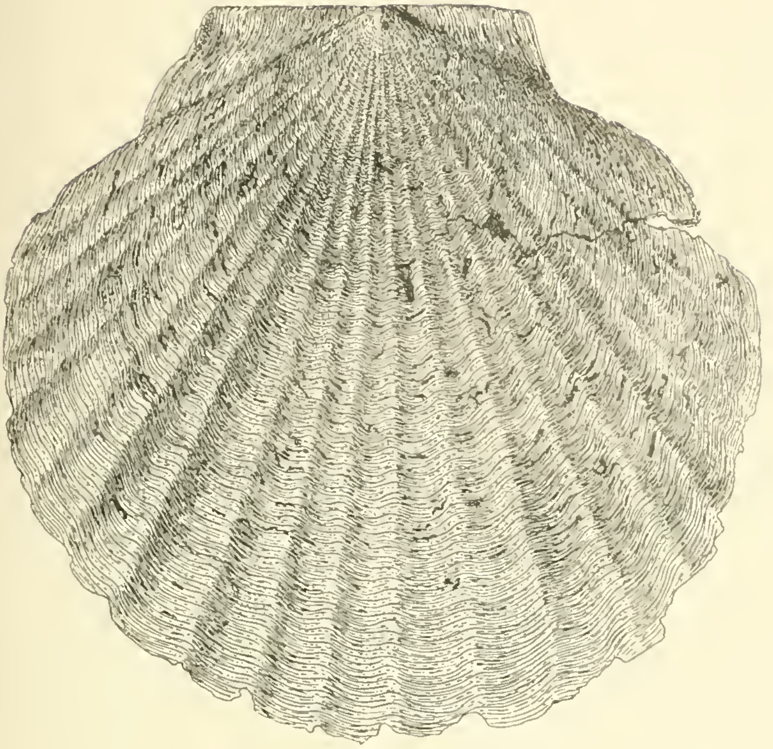
Fig. 1.	*Cooperella subdiaphana* Carpenter. Lower San Pedro series, Deadman Island. Interior, showing hinge. Longitude 12.5 mm.; ×5.	153
Fig. 2.	*Callista subdiaphana* var. *pedroana*, var. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 33 mm.; ×0.8.	144
Fig. 3.	*Aligena cerritensis*, sp. nov. Upper San Pedro series, Los Cerritos. Type specimen, view of interior. Longitude 10.9 mm.; ×3.	138
Fig. 4.	*Callista subdiaphana* Carpenter. Pliocene, Deadman Island. Longitude 45 mm.; ×0.8.	144
Fig. 5.	*Psephis tantilla* Gould. Lower San Pedro series, Deadman Island. View of interior. Longitude 6 mm.; ×4.	133
Fig. 6.	*Pecten (Patinopecten) caurinus* Gould. Pliocene, Deadman Island. Exterior of left valve. Altitude 122 mm.; ×0.8.	107
Fig. 7.	*Tellina (Moerella) salmonea* Carpenter. Lower San Pedro series, Deadman Island. Interior of right valve. Longitude 14 mm.; ×3.3.	157
Fig. 8.	*Donax lævigata* Deshayes. Upper San Pedro series, San Pedro. Interior view. Longitude 21 mm.; ×2.5.	170
Fig. 9.	*Donax californica* Conrad. Lower San Pedro series, Deadman Island. Interior view. Longitude 17 mm.; ×2.5.	170

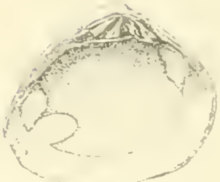

7

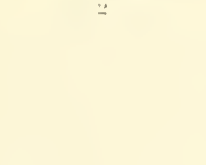

4

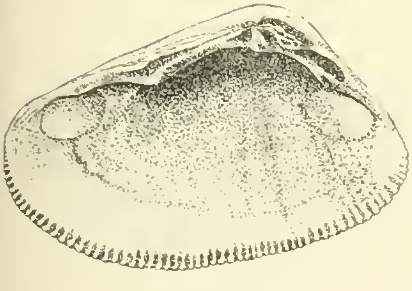

9

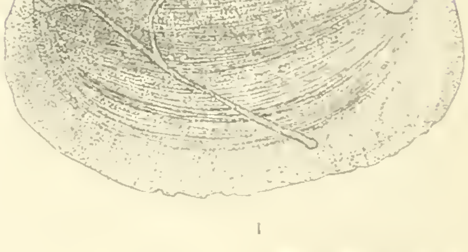

3


6


5


2


8


1

[illegible]

EXPLANATION OF PLATE XIV.

Fig. 1. *Venus (Chione) succincta* Valenciennes. Upper San Pedro series, San Pedro. Exterior of right valve. Longitude 54 mm.; natural size. 149

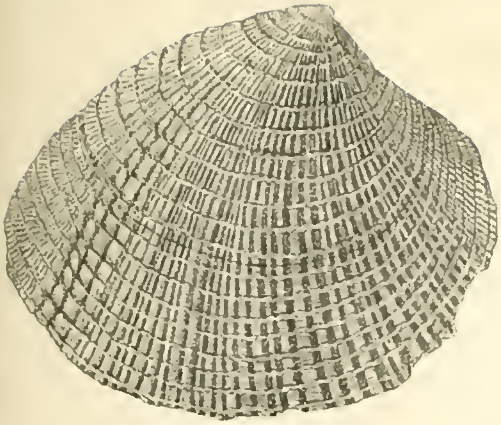
Fig. 2. *Venus (Chione) fluctifraga* Sowerby. Upper San Pedro series, San Pedro. Exterior of right valve. Longitude 25 mm.; ×1.7. 147

Fig. 3. *Venus (Chione) neglecta* Sowerby. Upper San Pedro series, San Pedro. Longitude 30 mm.; ×2.2. 148

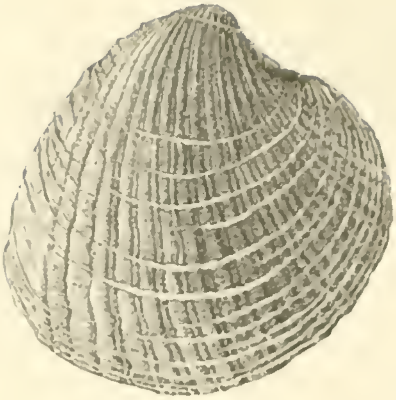
Fig. 4. *Tapes staminea* Conrad. Upper San Pedro series, San Pedro. Longitude 50 mm.; natural size. 150

Fig. 5. *Tapes lacineata* Carpenter. Upper San Pedro series, Los Cerritos. Longitude 10 mm.; ×1.1. 150

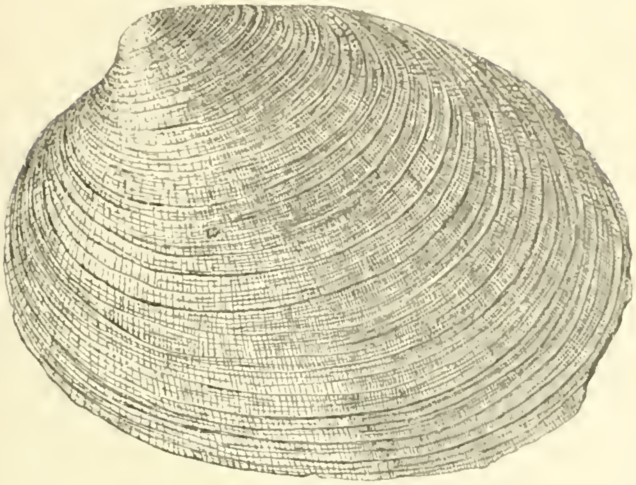
Fig. 6. *Tapes tenerrima* Carpenter. Upper San Pedro series, San Pedro. Longitude 84 mm.; natural size. 151



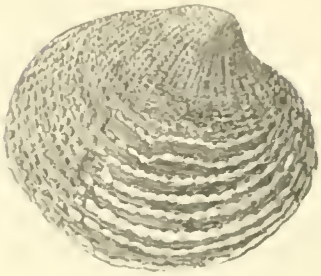
3



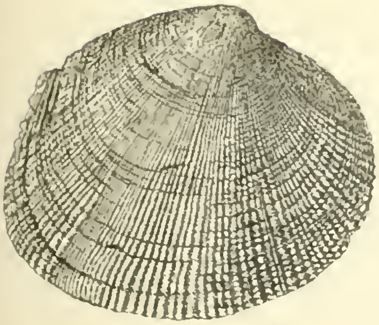
1



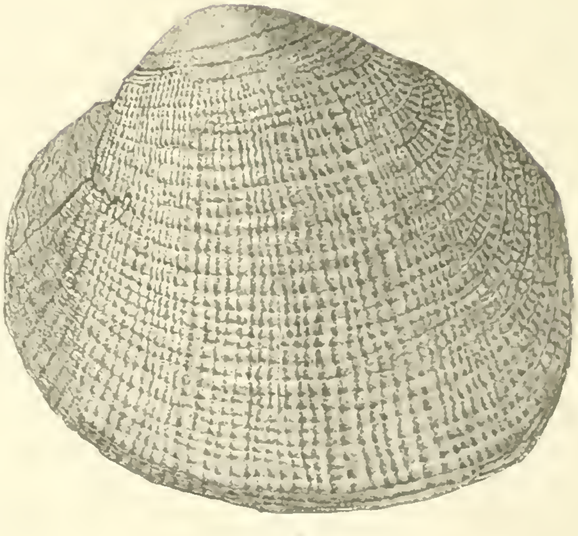
6



2



4



EXPLANATION OF PLATE XV.

Fig. 1. *Semele pulchra* Sowerby. Upper San Pedro series, San Pedro. Longitude 15 mm.; ×3.3. 166

Fig. 1*a*. Same. Outline, showing convexity of valve; ×3.3. 166

Fig. 2. *Tellina* (*Angulus*) *buttoni* Dall. Upper San Pedro series, San Pedro. Interior view. Longitude 13.5 mm.; ×4.6. 157

Fig. 3. Same as fig. 2. Exterior view; ×4.6. 157

Fig. 4. *Semele pulchra* var. *montereyi*, var. nov. Lower San Pedro series, Deadman Island. Longitude 14 mm.; ×3.3. 166

Fig. 4*a*. Same. Outline, showing convexity of valve; ×3.3. 166

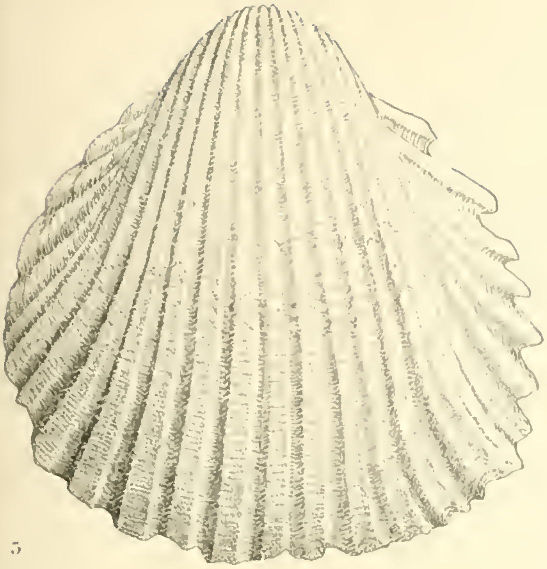
Fig. 5. *Thyasira bisecta* Conrad. Pliocene, Deadman Island. Longitude 74 mm.; ×1.1. 135

Fig. 6. *Cardium* (*Ringicardium*) *procerum* Sowerby. Upper San Pedro series, San Pedro. Exterior view. Longitude 73 mm.; natural size. 139

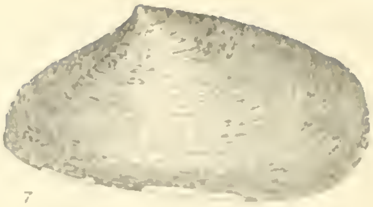
Fig. 7. *Tellina* (*Angulus*) *idæ* Dall. Upper San Pedro series, Los Cerritos. Longitude 62 mm.; ×0.7. 158

Fig. 8. *Tellina* (*Angulus*) *bodegensis* Hinds. Upper San Pedro series, San Pedro. Longitude 50 mm.; natural size. 158

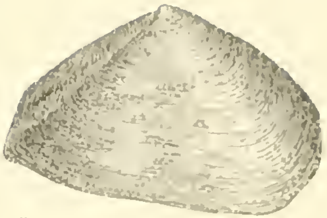
Fig. 9. *Tellina* (*Angulus*) *rubescens* Hanley. Upper San Pedro series, San Pedro. Longitude 42 mm.; natural size. 159



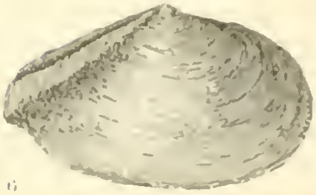
5



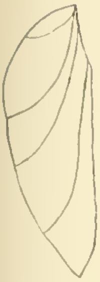
7



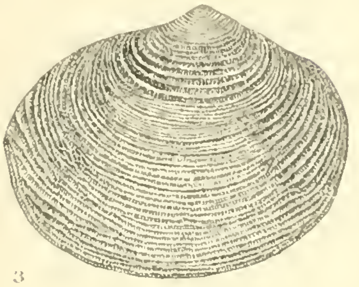
8



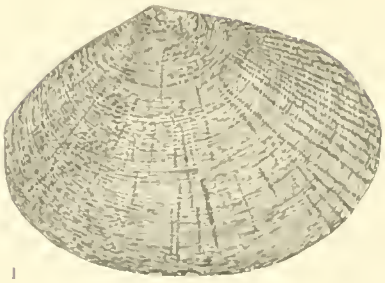
6



3 *a*



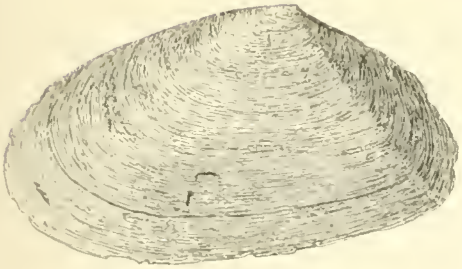
3



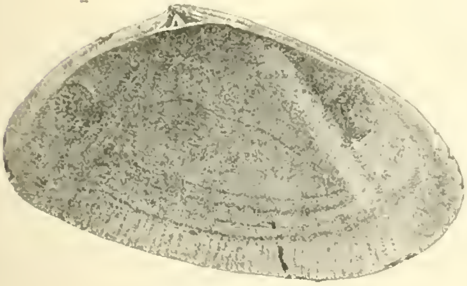
1

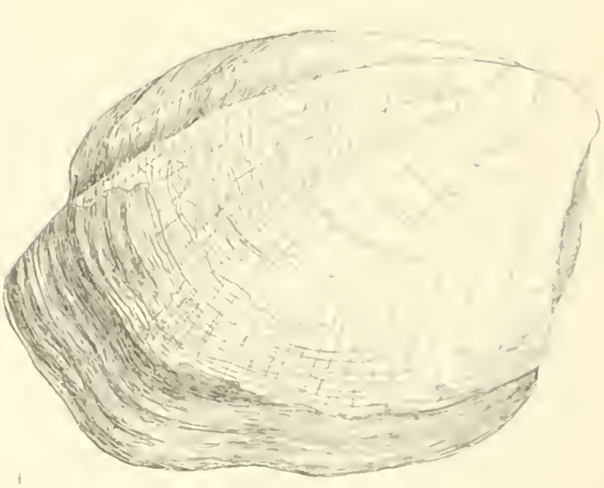
1 *a*

9



2

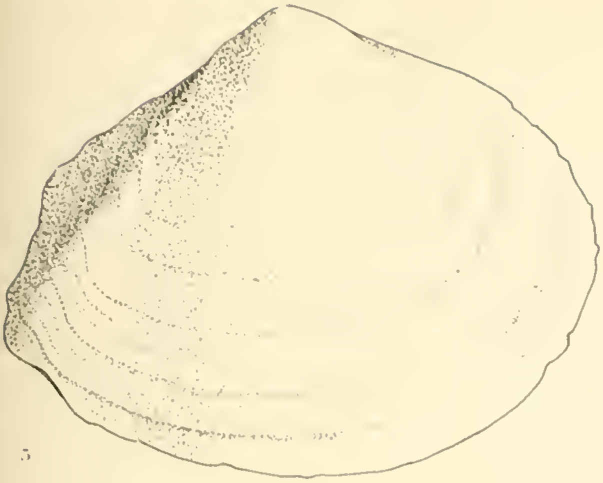




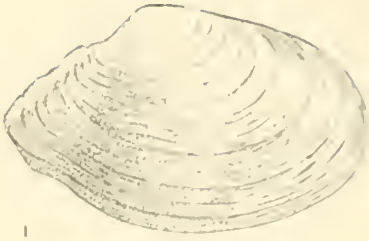
4

EXPLANATION OF PLATE XVI.

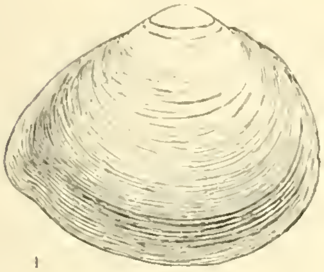
Fig. 1.	*Macoma indentata* Carpenter. Upper San Pedro series, Los Cerritos. Longitude 50 mm.; natural size.	161
Fig. 2.	*Macoma calcarea* Gmelin. Lower San Pedro series, Deadman Island. Longitude 18 mm.; ×2.3.	161
Fig. 3.	*Macoma nasuta* Conrad. Upper San Pedro series, San Pedro. Large, typical specimen. Longitude 75 mm.; natural size.	163
Fig. 4.	*Macoma inquinata* Deshayes. Upper San Pedro series, San Pedro. Longitude 42 mm.; natural size.	162
Fig. 5.	*Macoma secta* Conrad. Upper San Pedro series, San Pedro. Longitude 82 mm.; natural size.	164
Fig. 6.	*Macoma yoldiformis* Carpenter. Lower San Pedro series, Deadman Island. Longitude 24 mm.; natural size.	165
Fig. 7.	*Venus* (*Chione*) *gnidia* Broderip & Sowerby. Upper San Pedro series, San Pedro. Exterior of right valve. Longitude 96 mm.; natural size.	147



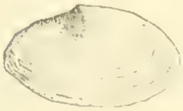
5



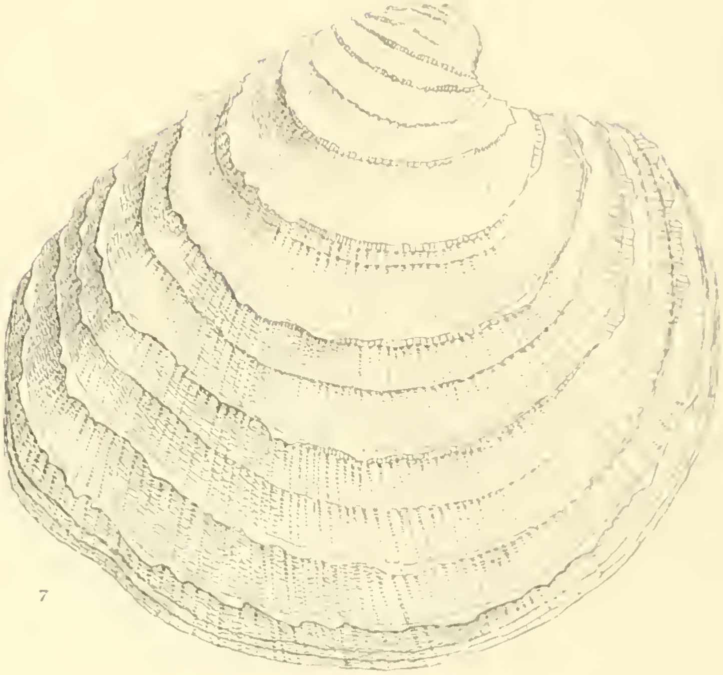
1



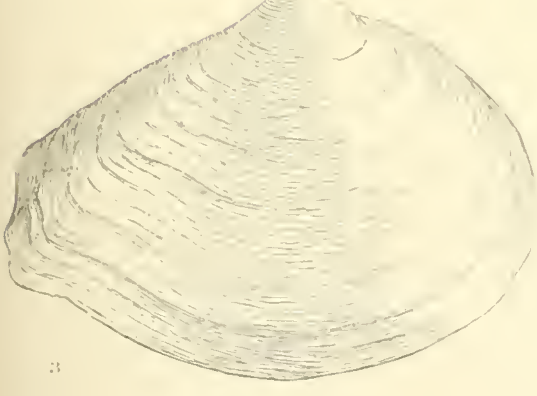
4



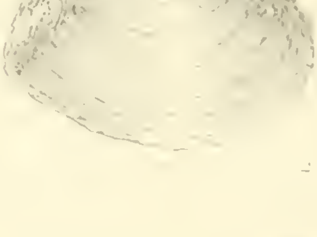
6



7



3



2

EXPLANATION OF PLATE XVII.

Fig. 1. *Terebratalia hemphilli* DALL. Pliocene, Santa Barbara. View of pedicle valve. Longitude 57 mm.; ×0.6. 92

Fig. 2. Same. Lateral view of both valves; ×0.6. 92

Fig. 3. Same. View of brachial valve; ×0.6. 92

Fig. 4. *Leda hamata* CARPENTER. Lower San Pedro series, Deadman Island. Longitude 9.5 mm.; ×4.5. 97

Fig. 5. *Leda taphria* DALL. Lower San Pedro series, Deadman Island. Longitude 9.6 mm.; ×4. 98

Fig. 6. *Leda minuta* var. *præcursor*, var. nov. Lower San Pedro series, Deadman Island. Type specimen. Longitude 9 mm.; ×5. 97

Fig. 7. *Leda fossa* BAIRD. Lower San Pedro series, Deadman Island. Longitude 13.5 mm.; ×3.2. 96

Fig. 8. *Mytilimeria nuttalli* CONRAD. Lower San Pedro series, Deadman Island. Altitude 17 mm.; ×1.4. 126

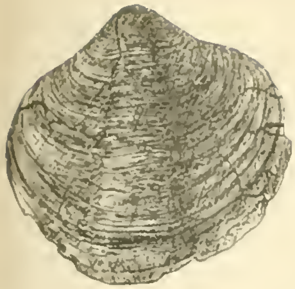
Fig. 9. *Terebratalia smithi*, sp. nov. Pliocene, Deadman Island. Type specimen. Altitude 50 mm.; natural size. 93

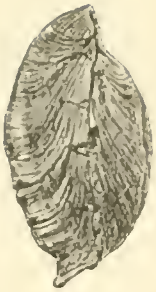
Fig. 10. *Verticordia novemcostata* ADAMS & REEVE. Lower San Pedro series, Deadman Island. Longitude 5 mm.; ×4.5. 126

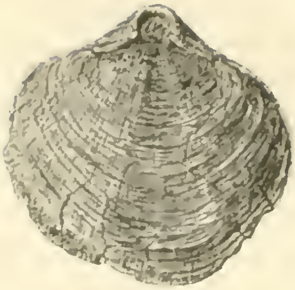
Fig. 11. *Corbula luteola* CARPENTER. Lower San Pedro series, Deadman Island. Longitude 8 mm.; ×3. 181

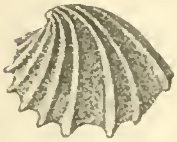
Fig. 12. *Bornia retifera* DALL. Lower San Pedro series, Deadman Island. Interior view, showing hinge. Longitude 7.5 mm.; ×4. 136

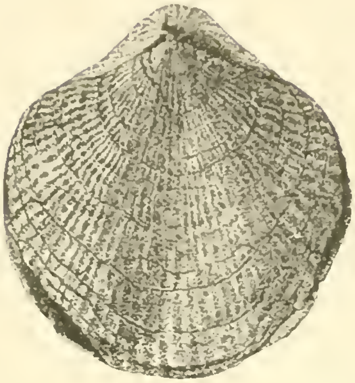
Fig. 13. *Yoldia scissurata* DALL. Lower San Pedro series, Deadman Island. Longitude 12.7 mm.; ×4. 99

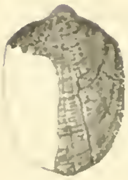

1

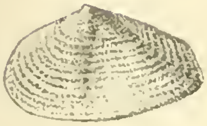

2

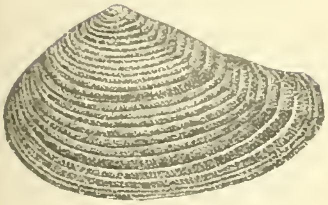

3

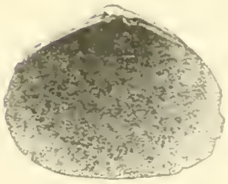

10

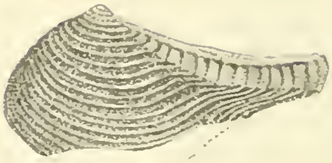

9

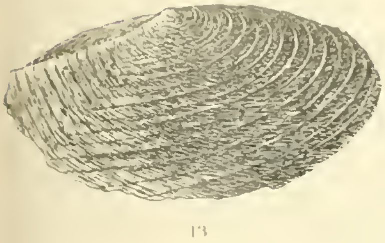

8

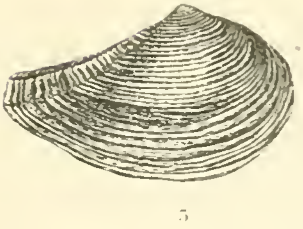

11

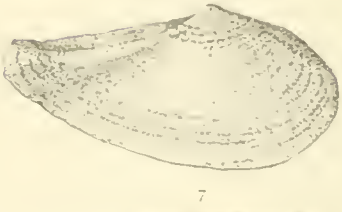

6


12


4


13


5


7

EXPLANATION OF PLATE XVIII.

Fig. 1. *Kellia suborbicularis* MONTAGU. Lower San Pedro series, Deadman Island. Interior view of left valve. Longitude 8 mm.; ×4.3. 137

Fig. 1*a*. Same specimen. Outline, showing convexity of valve; ×4.3. 137

Fig. 2. *Pandora* (*Kennerlia*) *bicarinata* CARPENTER. Lower San Pedro series, Deadman Island. View of imperfect left valve. Longitude 14 mm.; ×3. 123

Fig. 3. *Pandora* (*Kennerlia*) *filosa* CARPENTER. Lower San Pedro series, Deadman Island. Left valve. Longitude 15 mm.; ×3. 124

Fig. 4. *Arca labiata* SOWERBY. Upper San Pedro series, San Pedro. Longitude 28 mm.; ×1.3. 101

Fig. 5. *Diplodonta serricata* REEVE. Upper San Pedro series, San Pedro. Longitude 10.2 mm.; ×3.3. 134

Fig. 5*a*. Same. Outline, showing convexity of valve; ×3.3. 134

Fig. 6. *Nucula suprastriata* CARPENTER. Upper San Pedro series, Los Cerritos. Longitude 7 mm.; ×4.7. 96

Fig. 7. *Kellia laperousii* DESHAYES. Lower San Pedro series, Deadman Island. Interior view. Longitude 23 mm.; ×2. 137

Fig. 7*a*. Same. Outline, showing convexity of valve; ×2. 137

Fig. 8. *Diplodonta orbella* GOULD. Lower San Pedro series, Deadman Island. Longitude 9.2 mm.; ×3.3. 134

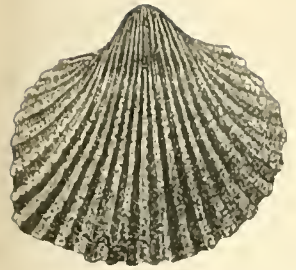
Fig. 8*a*. Same. Outline, showing convexity of valve; ×3.3. 134

Fig. 9. *Glycymeris barbarensis* CONRAD. Upper San Pedro series, San Pedro. View of interior. Longitude 25 mm.; ×1.3. 100

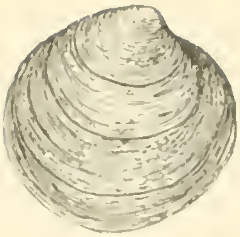
Fig. 10. *Glycymeris septentrionalis* MIDDENDORFF. Upper San Pedro series, San Pedro. View of interior. Longitude 22 mm.; ×1.3. 101

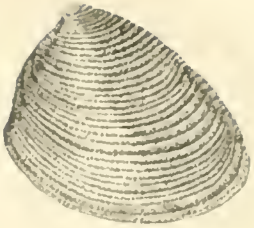
Fig. 11. *Neæra pectinata* CARPENTER. Lower San Pedro series, Deadman Island. Imperfect valve. Longitude 6.5 mm.; ×5.4. 181

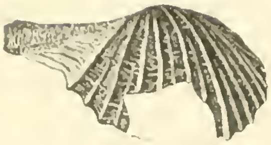
Fig. 12. *Astarte* (*Crassinella*) *branneri* sp. nov. Upper San Pedro series, Los Cerritos. Type specimen, interior view. Longitude 11.2 mm.; ×2.7. 127

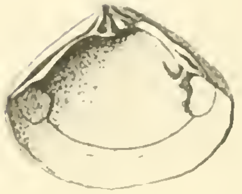

4

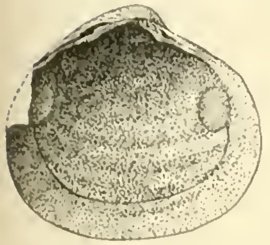
8 a

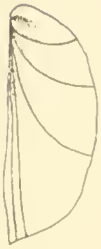

8

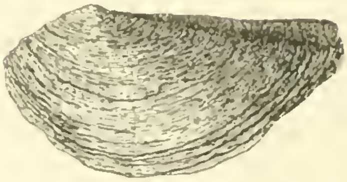

6

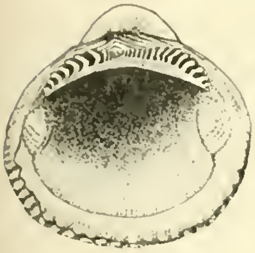

11

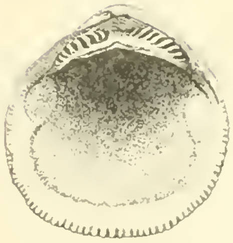

12

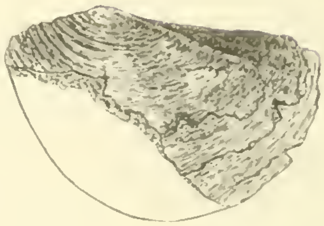

1


1 a

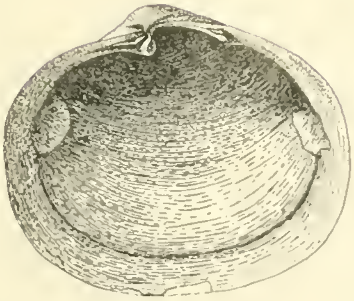

3


9

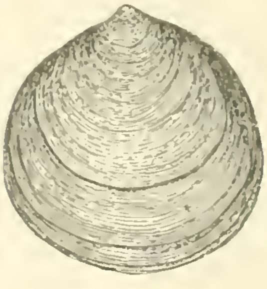

10


2

7 a


7

5 a


5

EXPLANATION OF PLATE XIX.

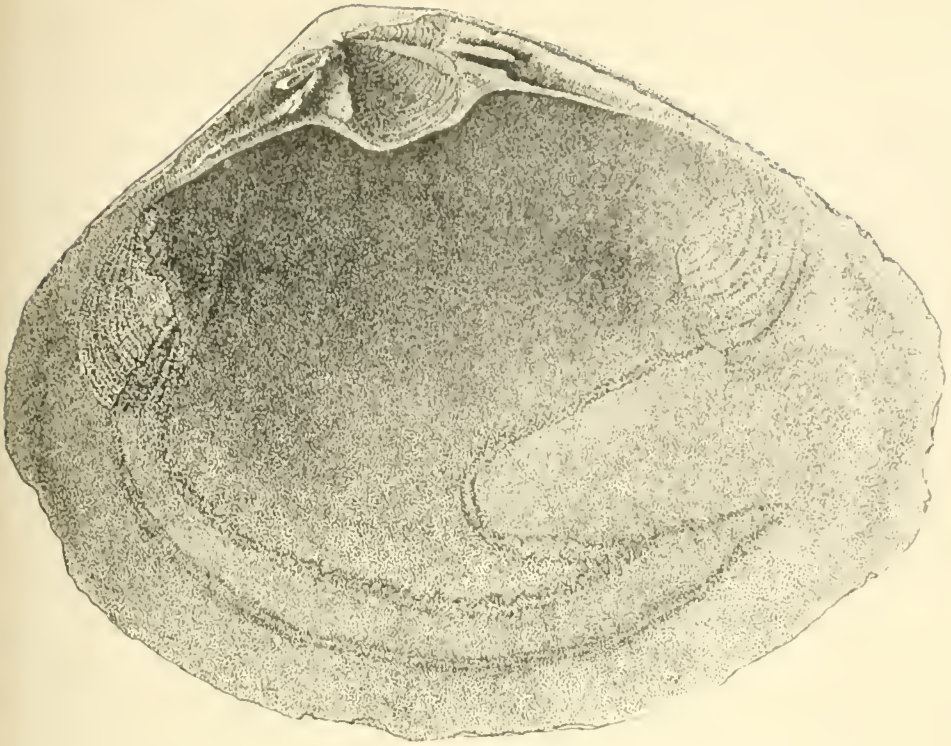
Fig. 1. *Mactra* (*Spisula*) *falcata* Gould. Upper San Pedro series, San Pedro. Interior of left valve. Longitude 47 mm.; natural size. 176

Fig. 2. *Mactra californica* Conrad. Upper San Pedro series, San Pedro. Interior of left valve. Longitude 39 mm.; natural size. 174

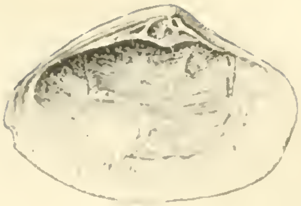
Fig. 3. *Mactra hemphilli* Dall. Upper San Pedro series, San Pedro. Interior of right valve. Longitude 124 mm; natural size. 175

Fig. 4. *Mactra exoleta* Gray. Upper San Pedro series, San Pedro. Interior view, right valve. Longitude 57 mm.; natural size. 175

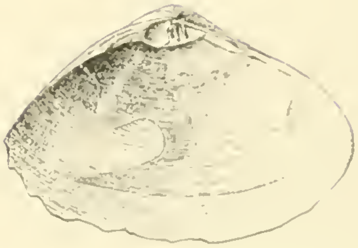
Fig. 5. *Mactra* (*Spisula*) *catilliformis* Conrad. Upper San Pedro series, San Pedro. Interior of right valve. Longitude 125 mm.; natural size. 176



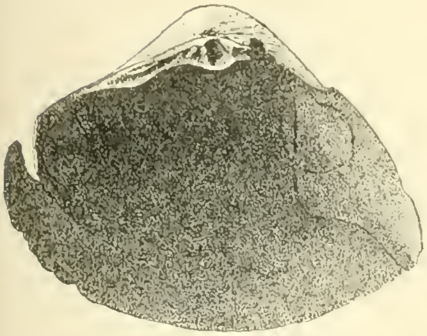
5



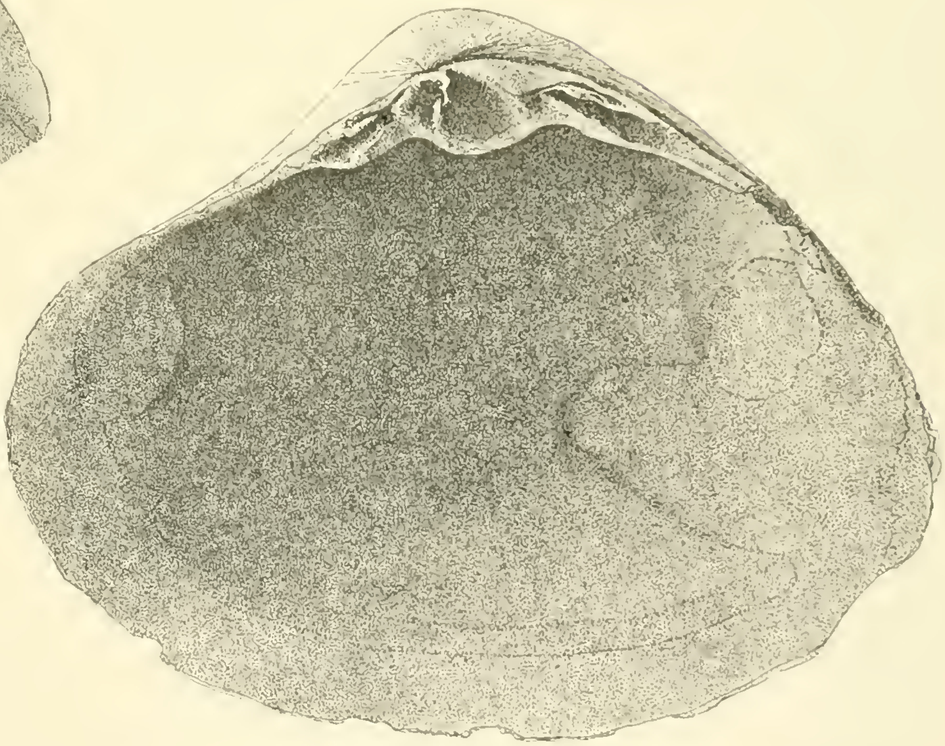
2



1



4

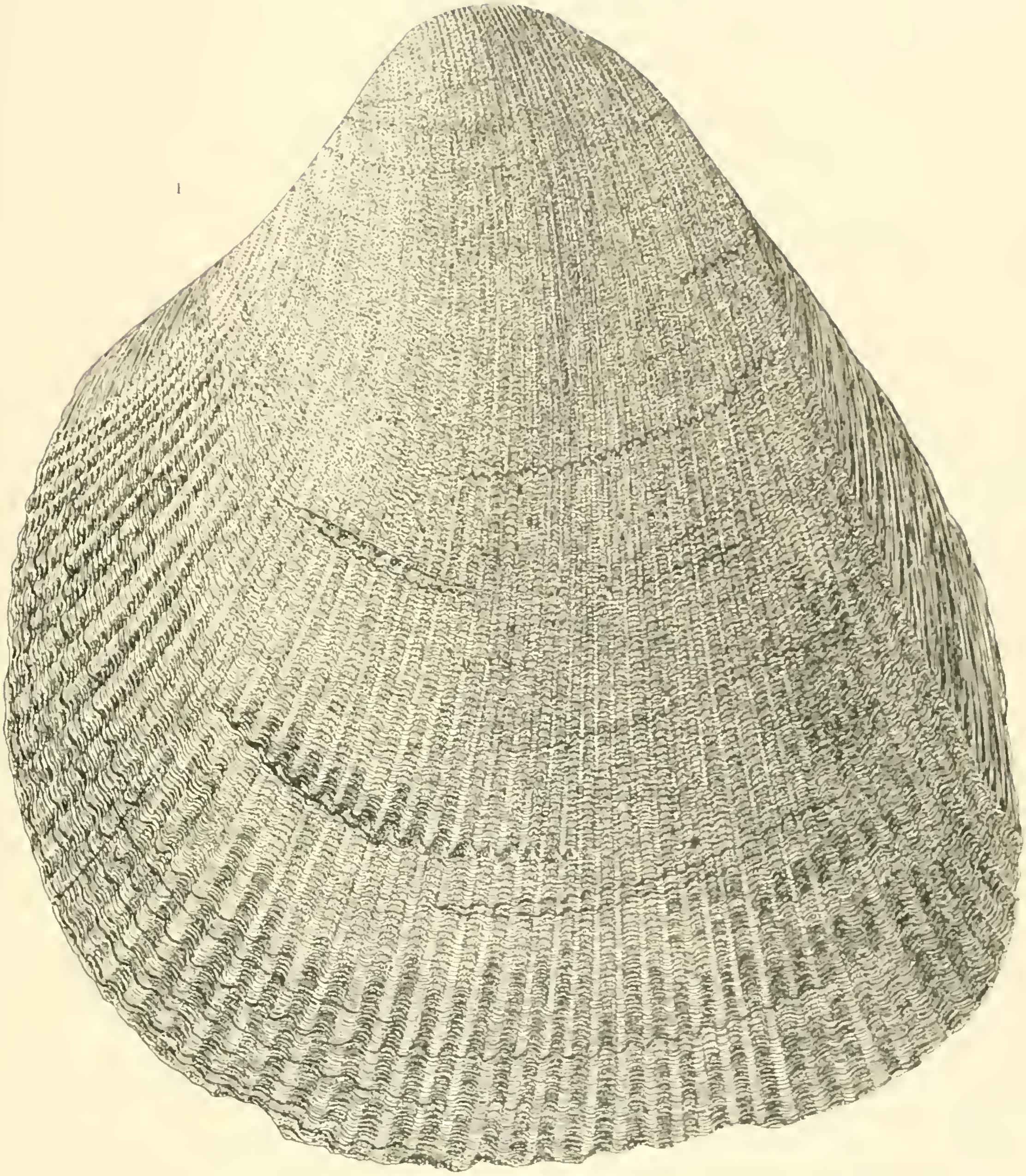


3

EXPLANATION OF PLATE XX.

Cardium (*Lævicardium*) *elatum* Sowerby. Upper San Pedro series, San Pedro. Exterior of left valve. Altitude 167 mm.; natural size. 141

1

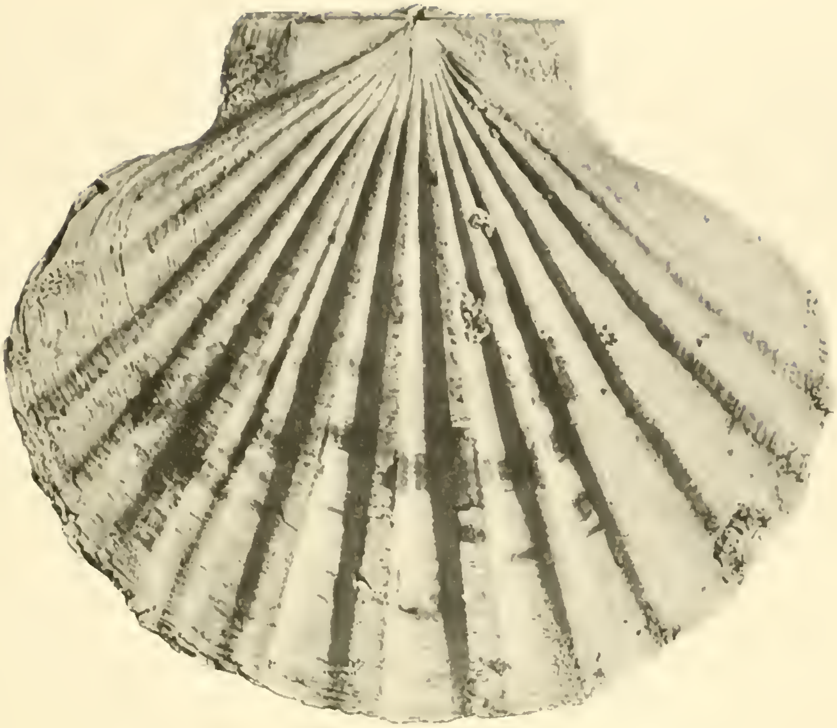


[illegible]

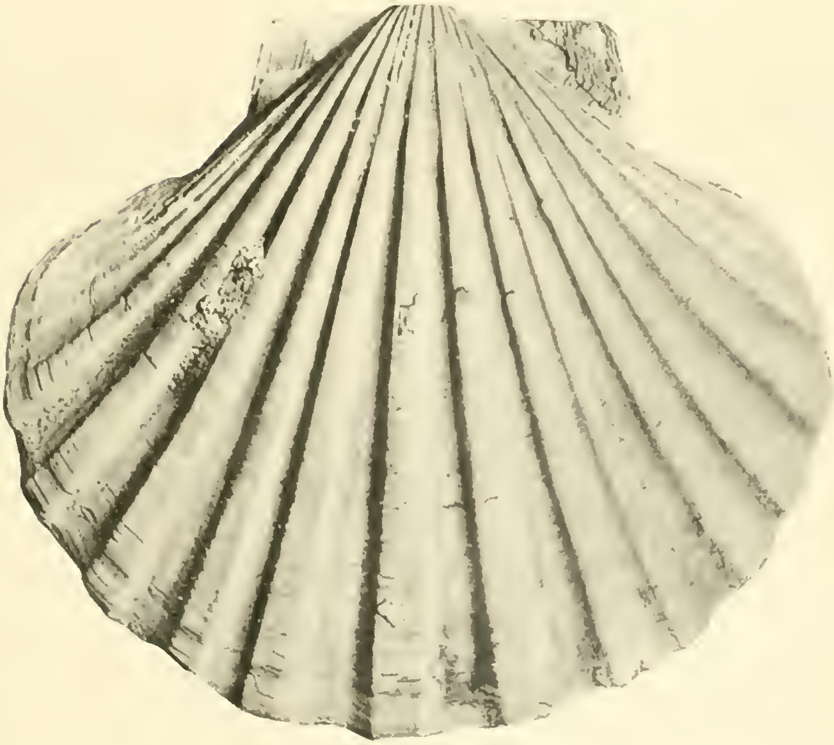
EXPLANATION OF PLATE XXI.

Fig. 1. *Pecten bellus* Conrad. Pliocene, Santa Barbara. Left valve of Gabb's type specimen of *Janira bella* (No. 960, Collection Academy of Natural Sciences, Philadelphia). Altitude 80 mm., slightly enlarged. 103

Fig. 2. Same. Right valve. 103



1



2.

DIAGRAM B.
Section
DEADMAN ISLAND.

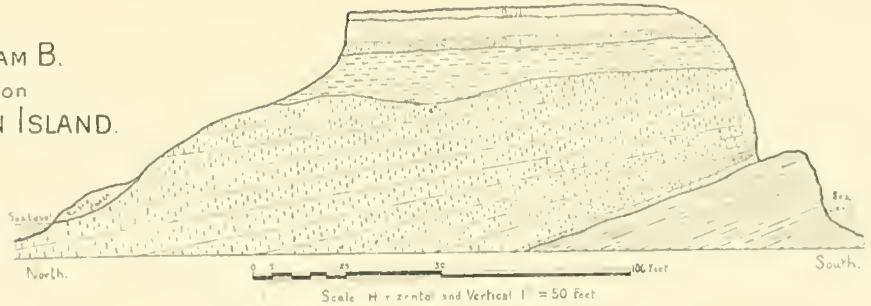
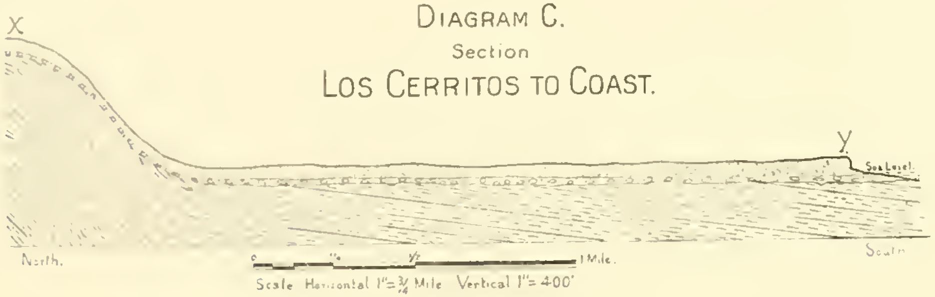

Sea Level
North.
South.
Sea
0
5
25
50
100 Feet
Scale Horizontal and Vertical 1" = 50 Feet

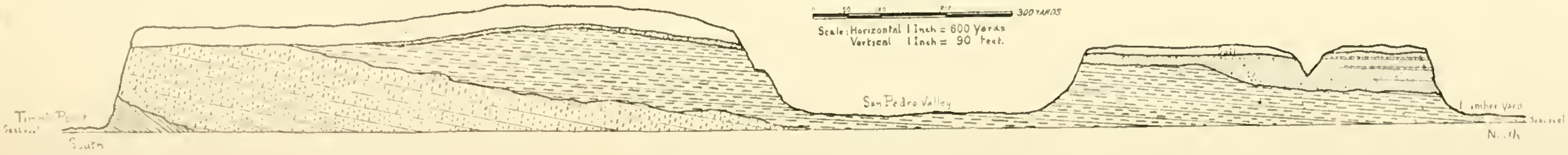
DIAGRAM C.
Section
LOS CERRITOS TO COAST.


X
Y
Sea Level
North.
South.
0
1/4
1/2
1 Mile.
Scale Horizontal 1" = 3/4 Mile Vertical 1" = 400'

Legend.

▨	Upper San Pedro Series	Pleistocene	Sands and Gravels
▤	Lower San Pedro Series		White Sands
▦	San Diego Formation	Pliocene.	Brown Sands
▤	Miocene Series.	Miocene.	Hard Shales.

DIAGRAM D.
Section
SAN PEDRO WATER FRONT


Timms' Point
Sea Level
South
San Pedro Valley
Lumber Yard
Sea Level
North
0
50
100
200
300 YARDS
Scale: Horizontal 1 Inch = 600 Yards
Vertical 1 Inch = 90 Feet.

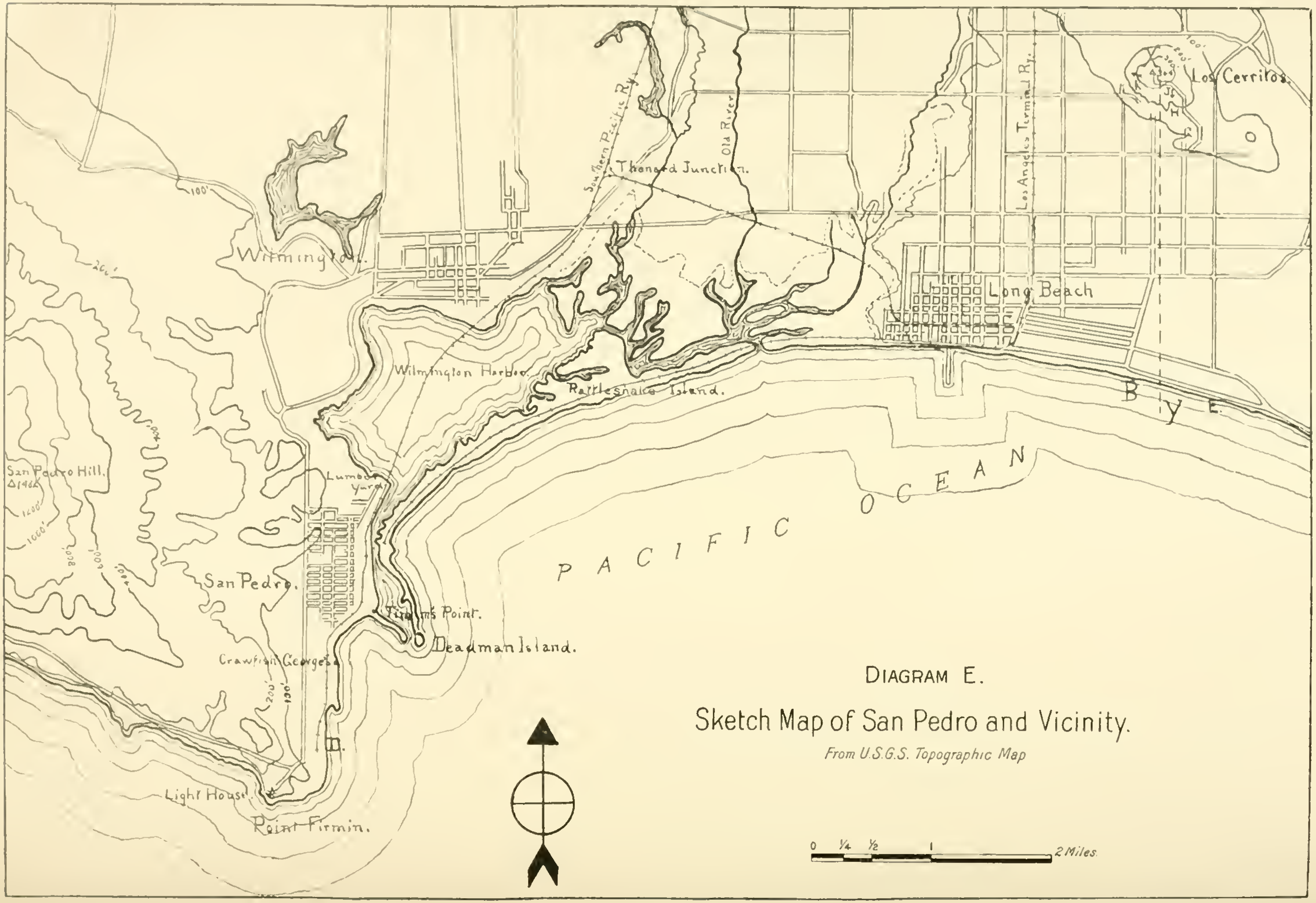

Los Cerritos.
Southern Pacific Ry.
Old River
Thenard Junction.
Los Angeles Terminal Ry.
100'
200'
Wilmington.
Long Beach
Wilmington Harbor.
Rattlesnake Island.
B
y
E.
San Pedro Hill.
Δ1462
1200'
1000'
800'
600'
400'
Lumber Yard
San Pedro.
Timm's Point.
Deadman Island.
Crawfish George's.
200'
100'
Light House.
Point Firmin.
PACIFIC OCEAN
0
¼
½
1
2 Miles

DIAGRAM E.

Sketch Map of San Pedro and Vicinity.

From U.S.G.S. Topographic Map

PHOTO LITH BRITTON & REY S.F.

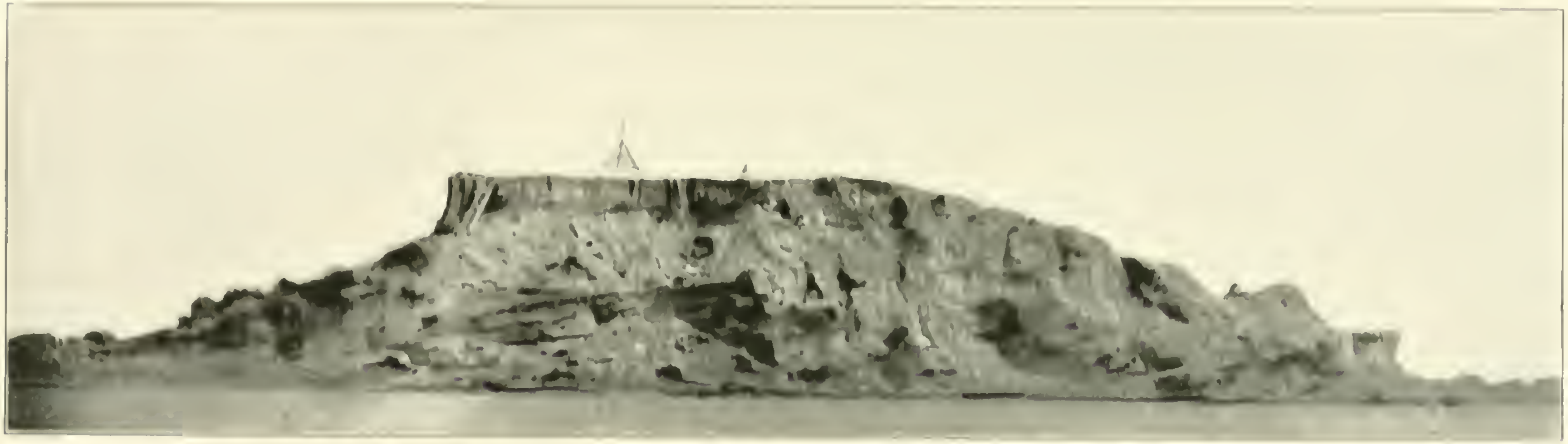


Figure a. San Pedro.—West face of Deadman Island from breakwater, showing Miocene, Pliocene and Pleistocene strata. (See Diagram B, Plate XXII, for explanation.)

Photograph by R. Arnold.

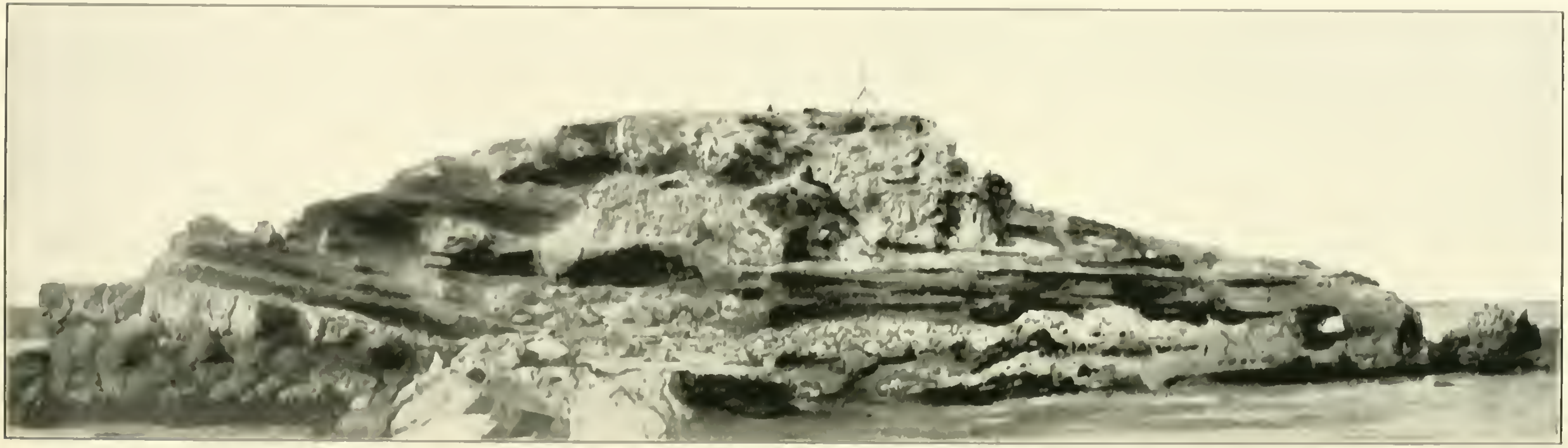


Figure b. San Pedro.—South face of Deadman Island from breakwater, showing Miocene on left, overlain by Pliocene, above which is the Pleistocene. (See Diagram B, Plate XXII, for explanation.)

Photograph by R. Arnold.

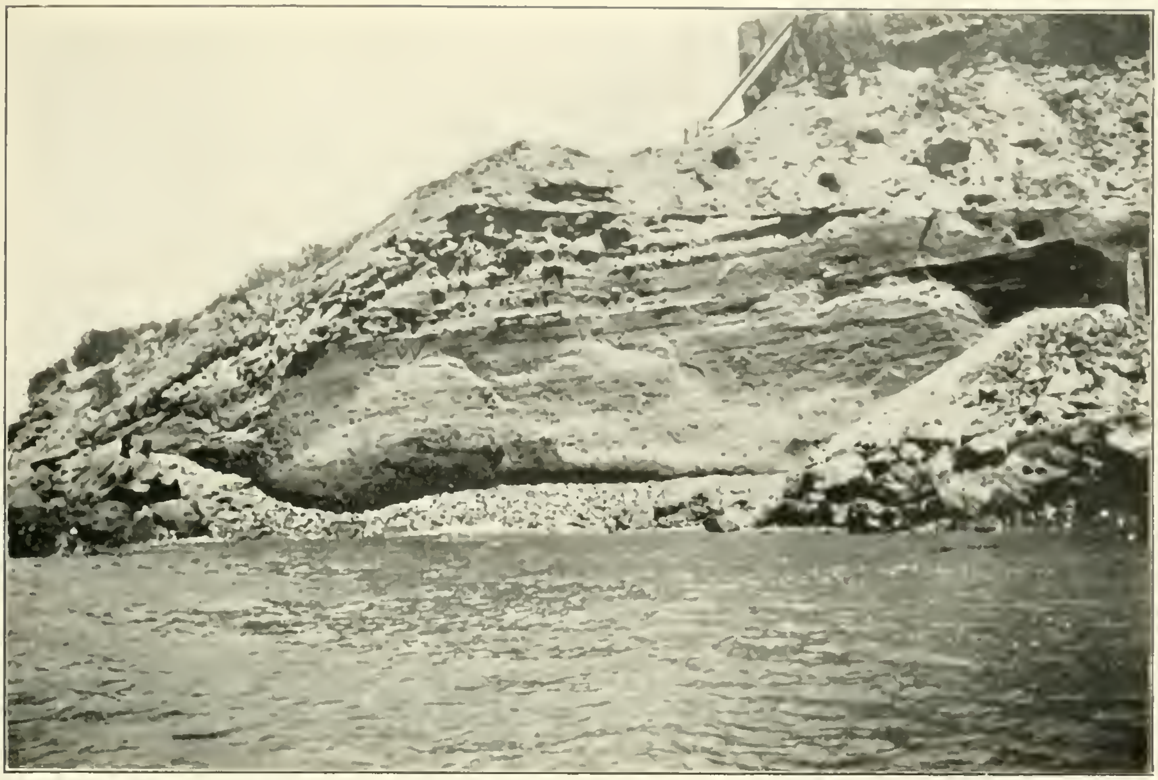


Figure a. San Pedro.—North end of Deadman Island, looking east, showing unconformity between Pliocene and lower San Pedro (Pleistocene) strata. (See Diagram B, Plate XXII, for explanation.)

Photograph by R. Arnold.

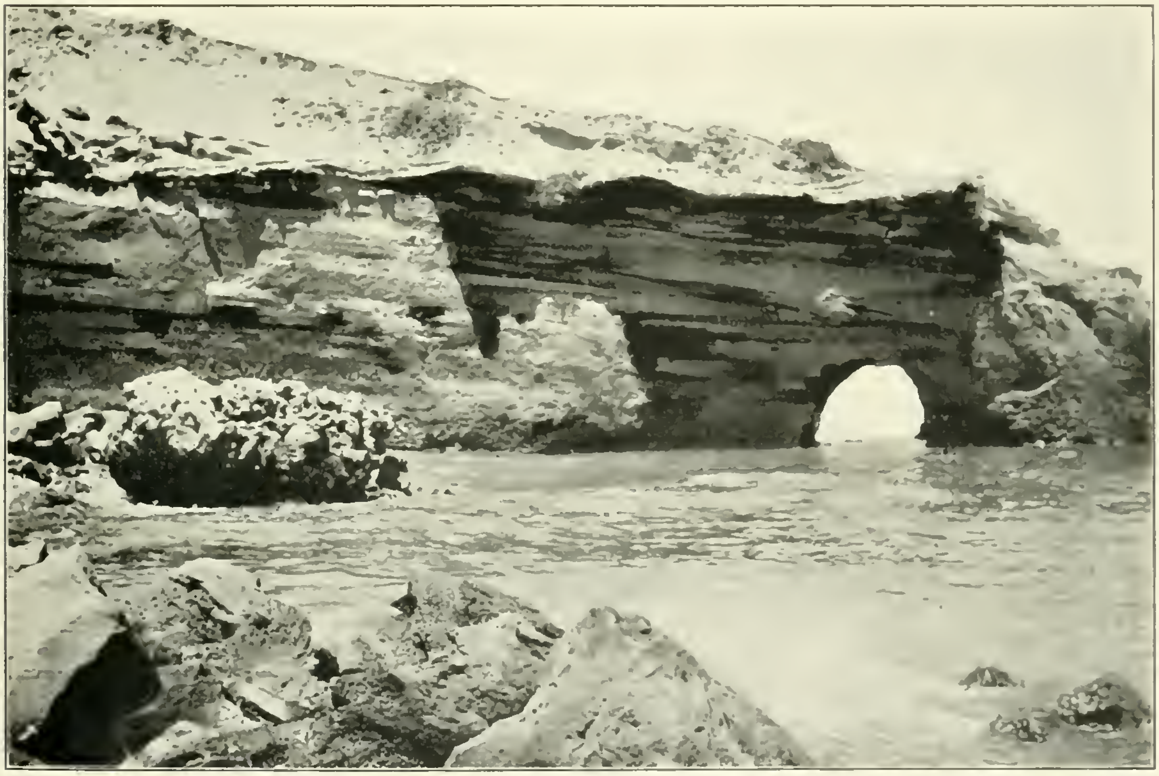


Figure b. San Pedro.—East point of Deadman Island, looking north, showing unconformity between Pliocene and lower San Pedro (Pleistocene) strata.

Photograph by R. Arnold.

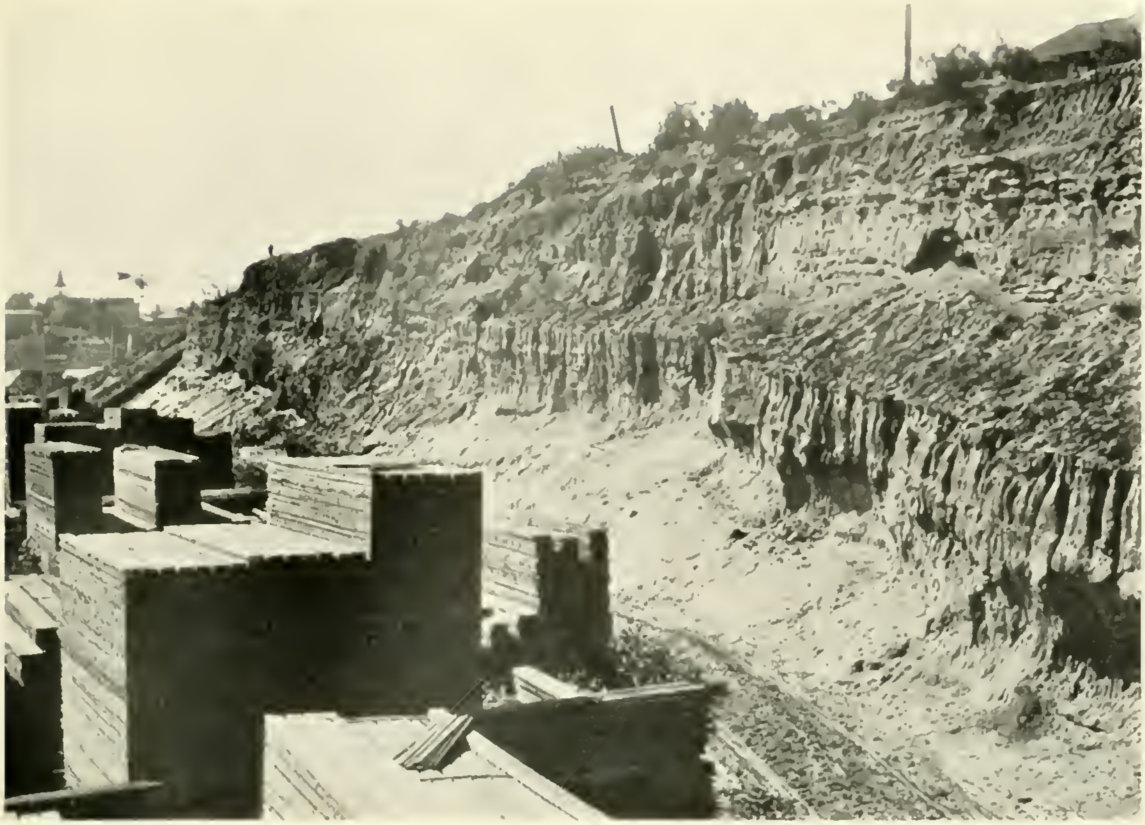


Figure a. San Pedro.—San Pedro bluff, looking southwest toward the San Pedro valley, showing lower and upper San Pedro (Pleistocene) strata. (See Diagram D, Plate XXII, for explanation.)

Photograph by R. Arnold.

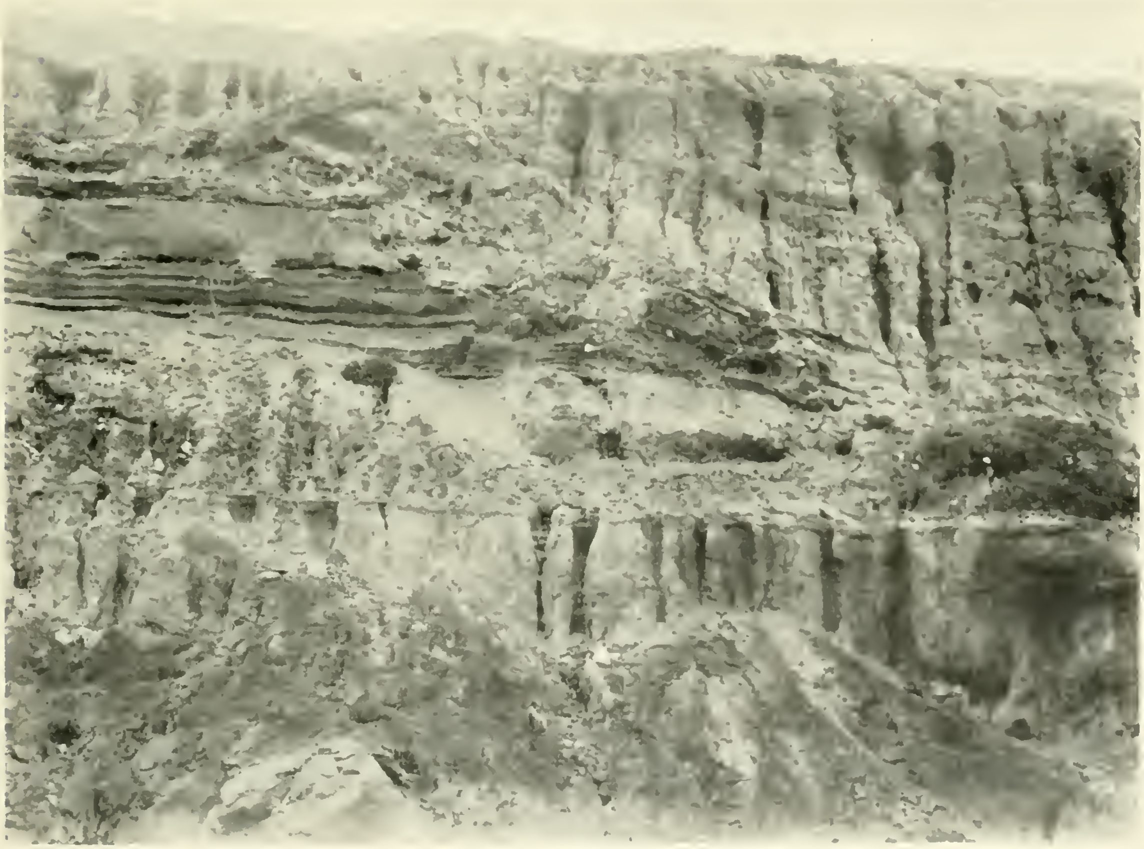


Figure b. San Pedro.—San Pedro bluff north of valley, looking west showing unconformity between lower and upper San Pedro (Pleistocene) deposits. (See Diagram D, Plate XXII, for explanation.)

Photograph by Dr. H. W. Fairbanks.

Figure a. San Pedro.—North end of the San Pedro bluff, looking northwest, showing fossiliferous layers near top. Photograph by R. Arnold.

Figure b. San Pedro.—North end of the San Pedro bluff, looking northwest, showing fossiliferous layers at the bottom. Photograph by R. Arnold.

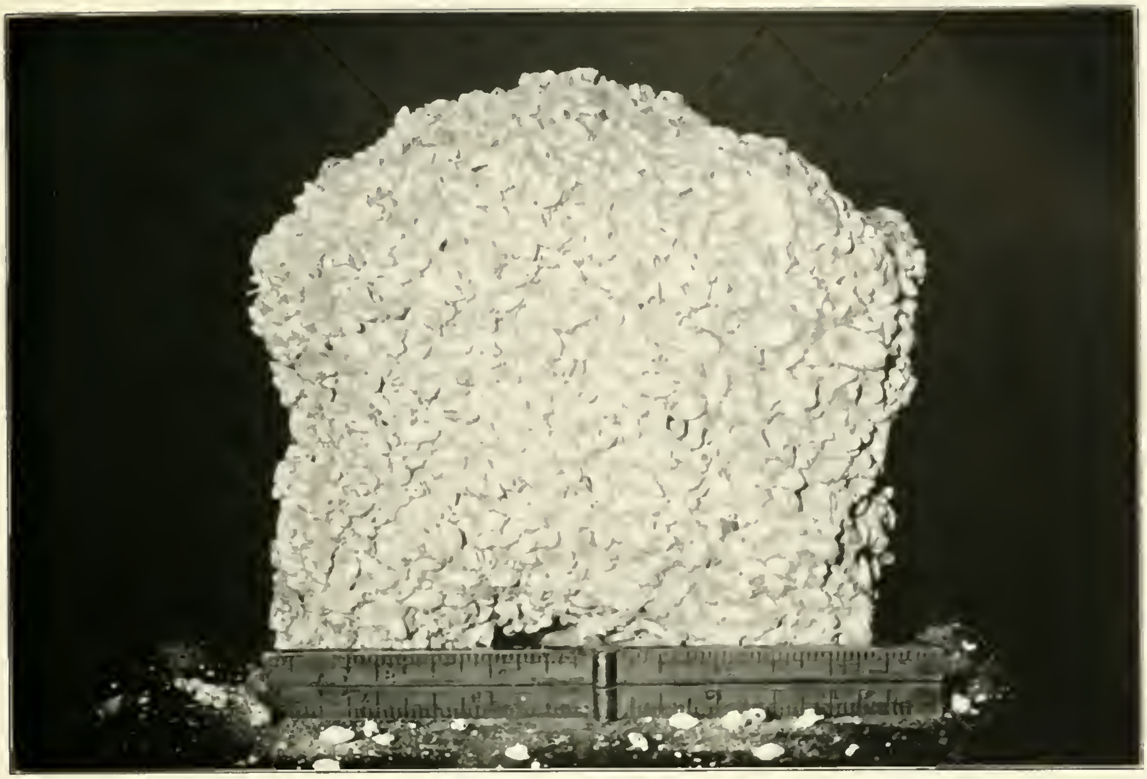


Figure a. San Pedro.—Specimen of the fossiliferous sand from the lower San Pedro deposits, San Pedro bluff, north of valley. Olivella intorta is the dominating species.

Photograph by R. Arnold.

Figure b. San Pedro.—Specimen of the fossiliferous lower San Pedro sandstone from Deadman Island.

Photograph by R. Arnold.

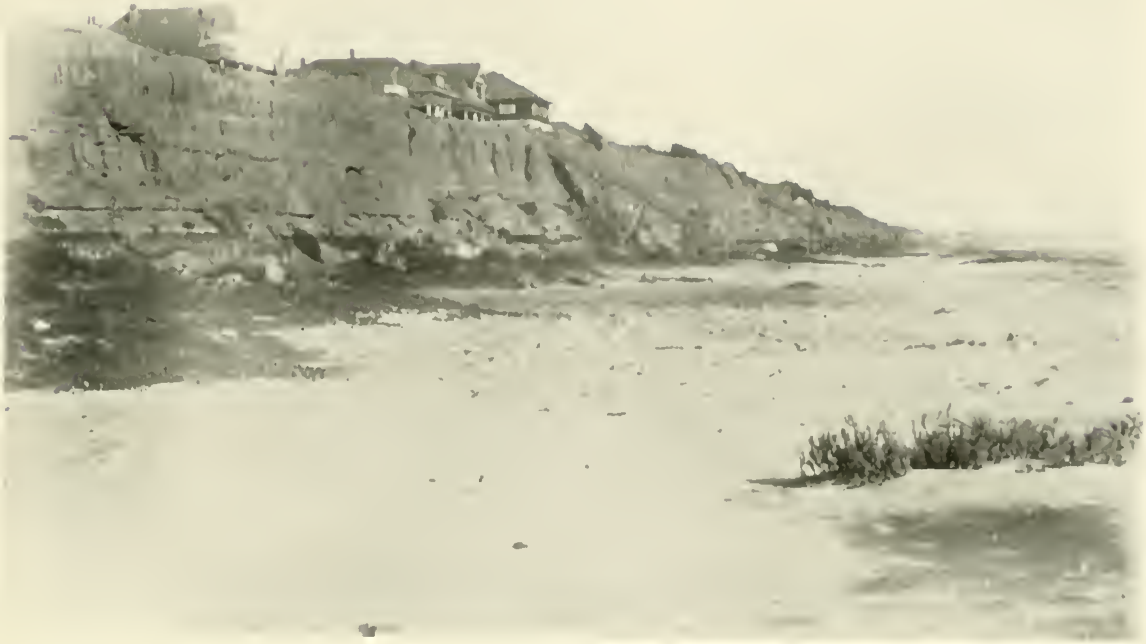


Figure a. Long Beach.—Bluff at Alamitos Beach, looking east, showing horizontal upper San Pedro (Pleistocene) strata. Photograph by R. Arnold.

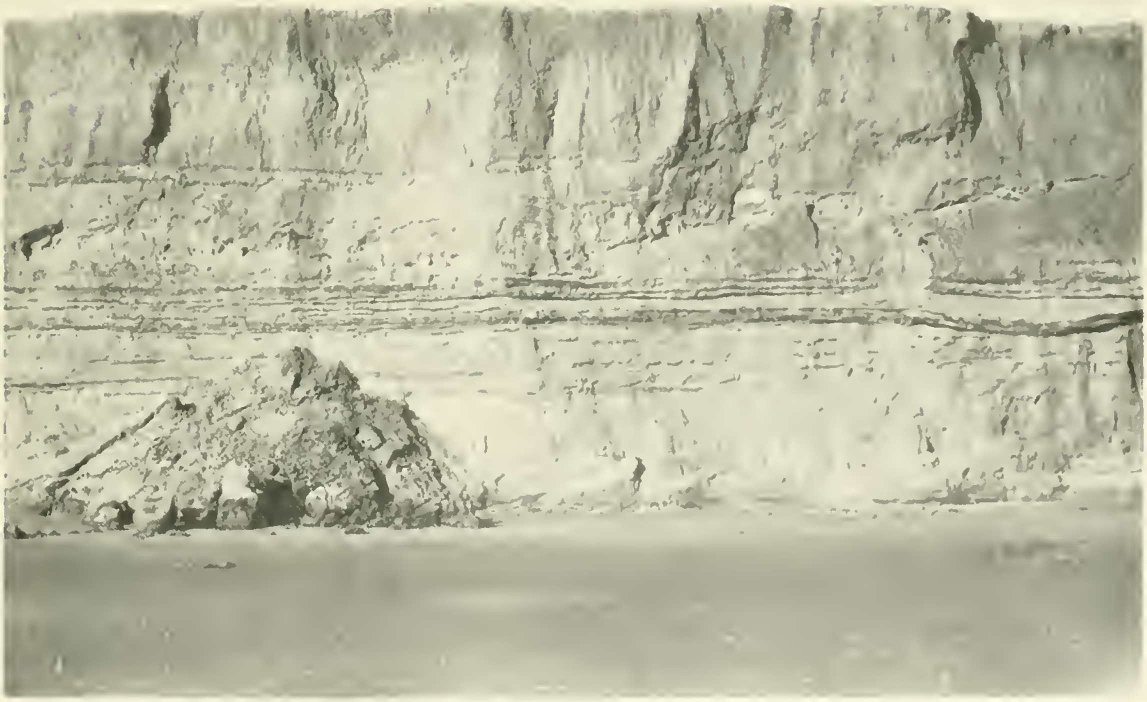


Figure b. Long Beach.—Typical section of the upper San Pedro (Pleistocene) bluff east of Long Beach. (Lowest visible layer composed of fossil shells). Photograph by R. Arnold.

Figure a. San Pedro.—South end of the lowest San Pedro terrace, looking northeast from Crawfish George's toward Timm's Point, showing the contorted Miocene shales overlain by the thin horizontal upper San Pedro (Pleistocene) layer. Photograph by R. Arnold.

Figure b. Port Harford.—Railroad cut at Fossil Point, looking south, showing Indian kitchen-midden six feet thick and full of shells overlying the Pleistocene deposit of brecciated shale.

Photograph by R. Arnold.

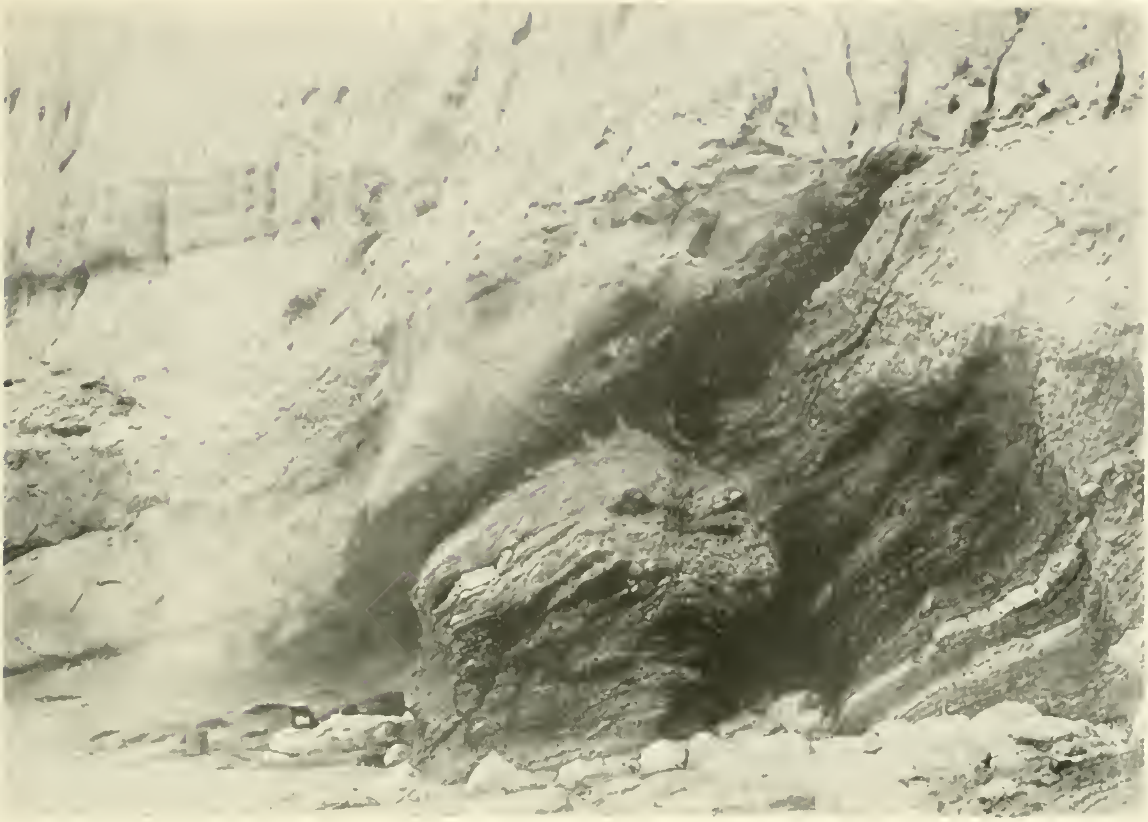


Figure a. Pismo.—Section of sea-cliff three miles northwest of Pismo, showing Miocene shales on right, overlain unconformably by San Pablo (Middle Neocene) sandstone on left, the whole capped by horizontal Pleistocene deposits of brecciated shale. Photograph by R. Arnold.

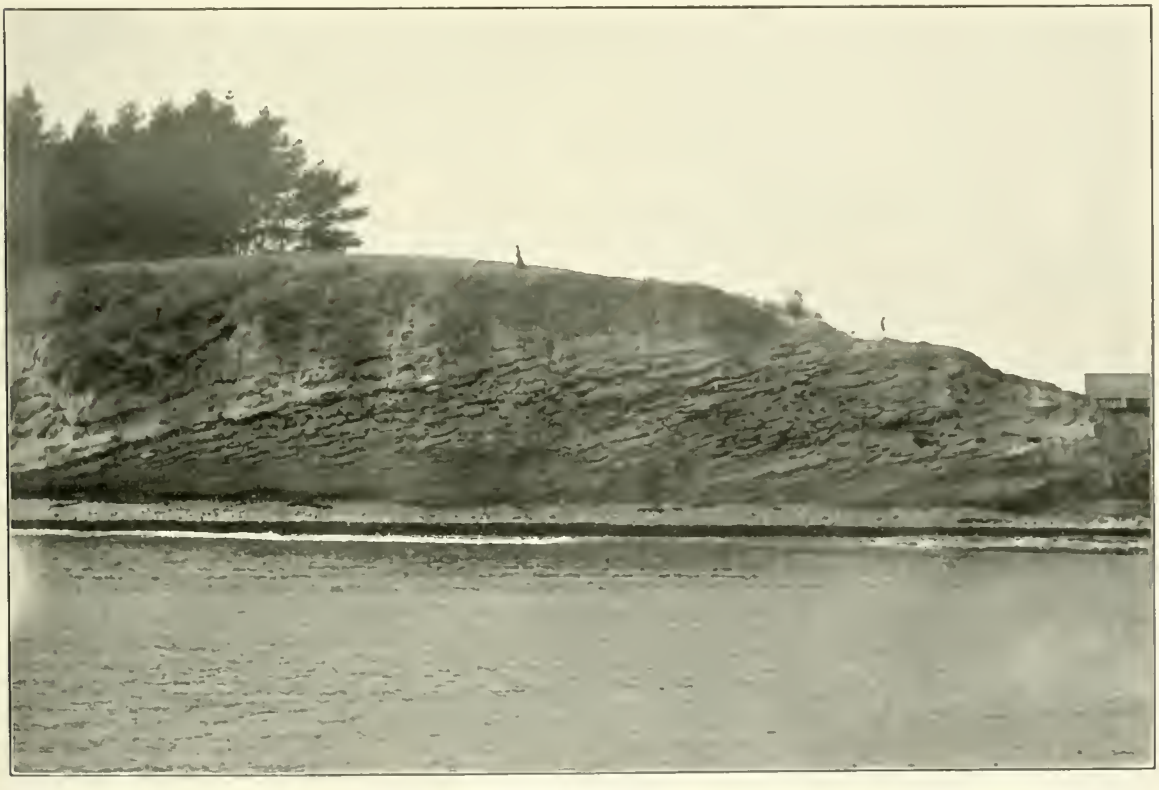


Figure b. Santa Barbara.—Bluff just west of the bath-house, showing alternating hard and soft layers of the lower San Pedro (Pleistocene) sandstone. Photograph by R. Arnold.

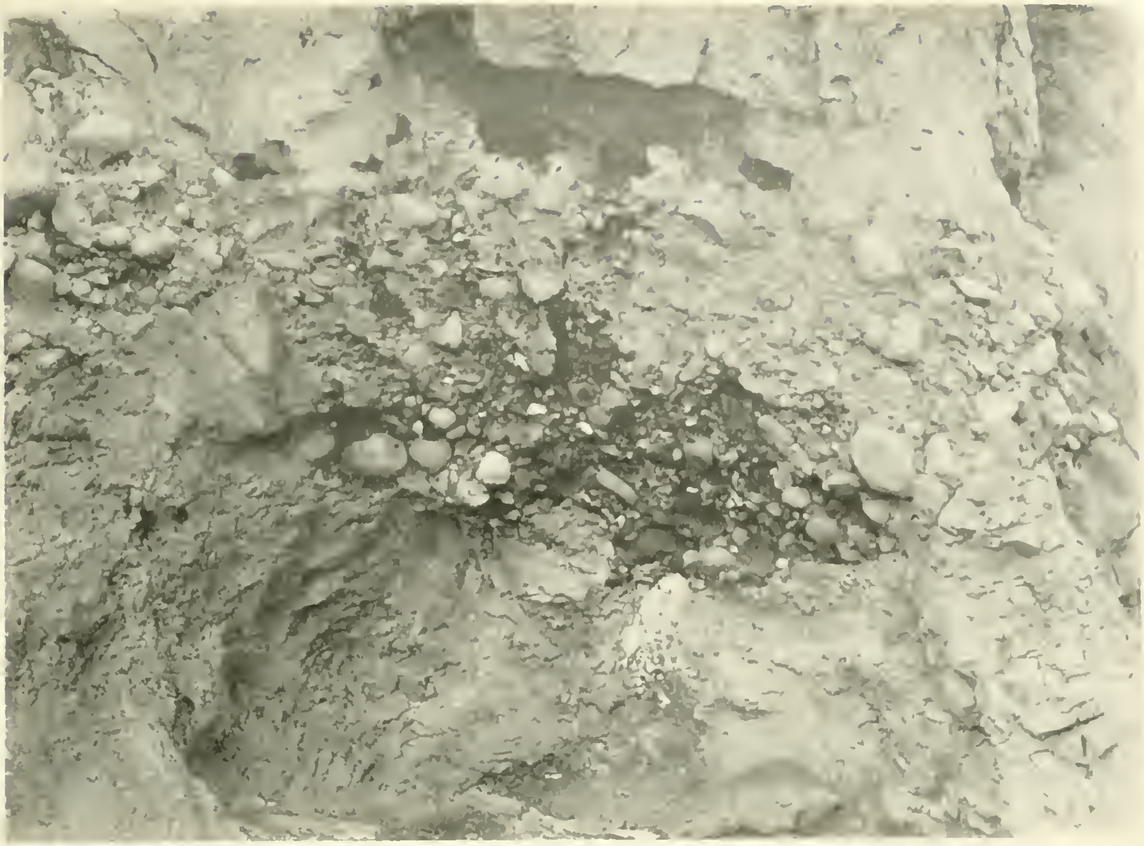


Figure a. Santa Barbara.—Portion of bluff west of Rocky Point, showing asphaltum-impregnated Pleistocene gravels resting on the Miocene shales. Photograph by R. Arnold.

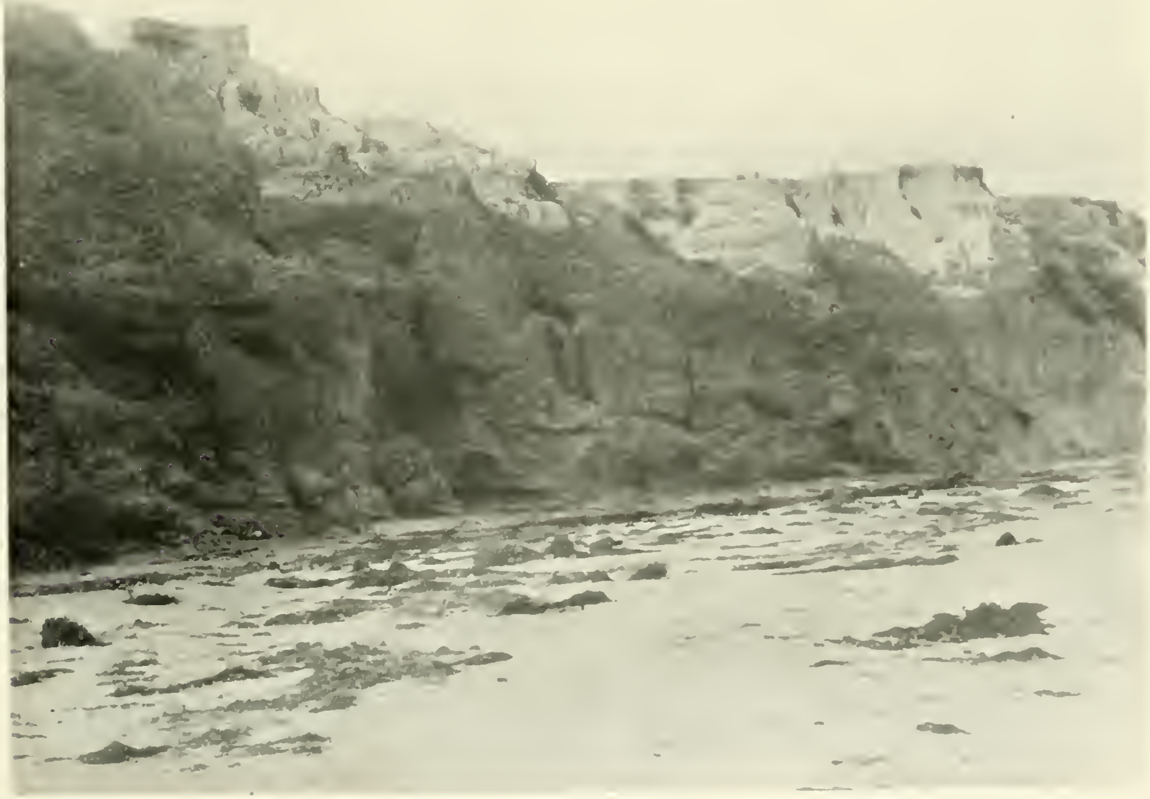


Figure b. Santa Barbara.—Bluff west of Rocky Point, showing the Pleistocene sands and gravels resting on the Miocene shales. Photograph by R. Arnold.

Figure a. Ventura.—West side of the Ojai Valley, looking west from the boulevard, showing two of the three wave-cut terraces in Pleistocene sediments. Photograph by R. Arnold.

Figure b. Ventura.—Hills north of Ventura composed of Pleistocene sediments, looking northeast. The old irrigating ditch is seen about half way up the hill. Photograph by R. Arnold.

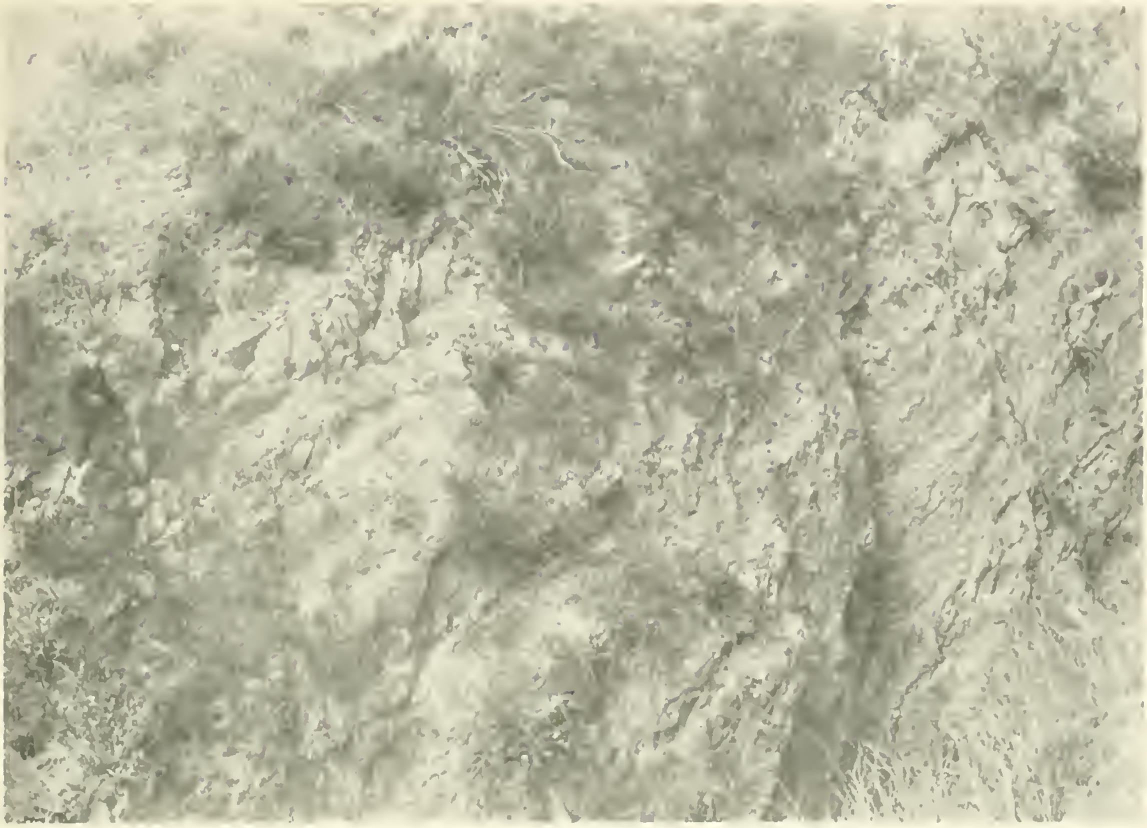


Figure a. Ventura.—Side of ravine above the Barlow ranch house, looking west, showing fossiliferous upper San Pedro (Pleistocene) beds at an elevation of over six hundred feet above sea-level, dipping at an angle of over 40°.

Photograph by R. Arnold.

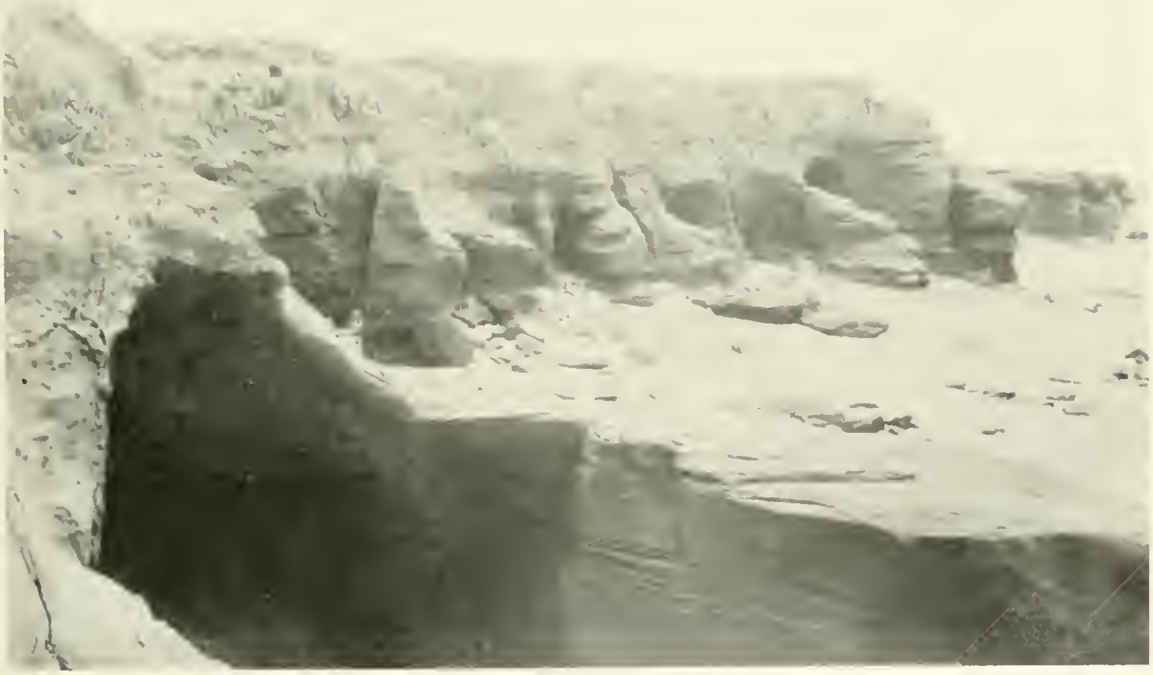


Figure b. San Diego.—Bluff at La Jolla capped by Pleistocene deposit of gravel and sand.

Photograph by F. L. Park.

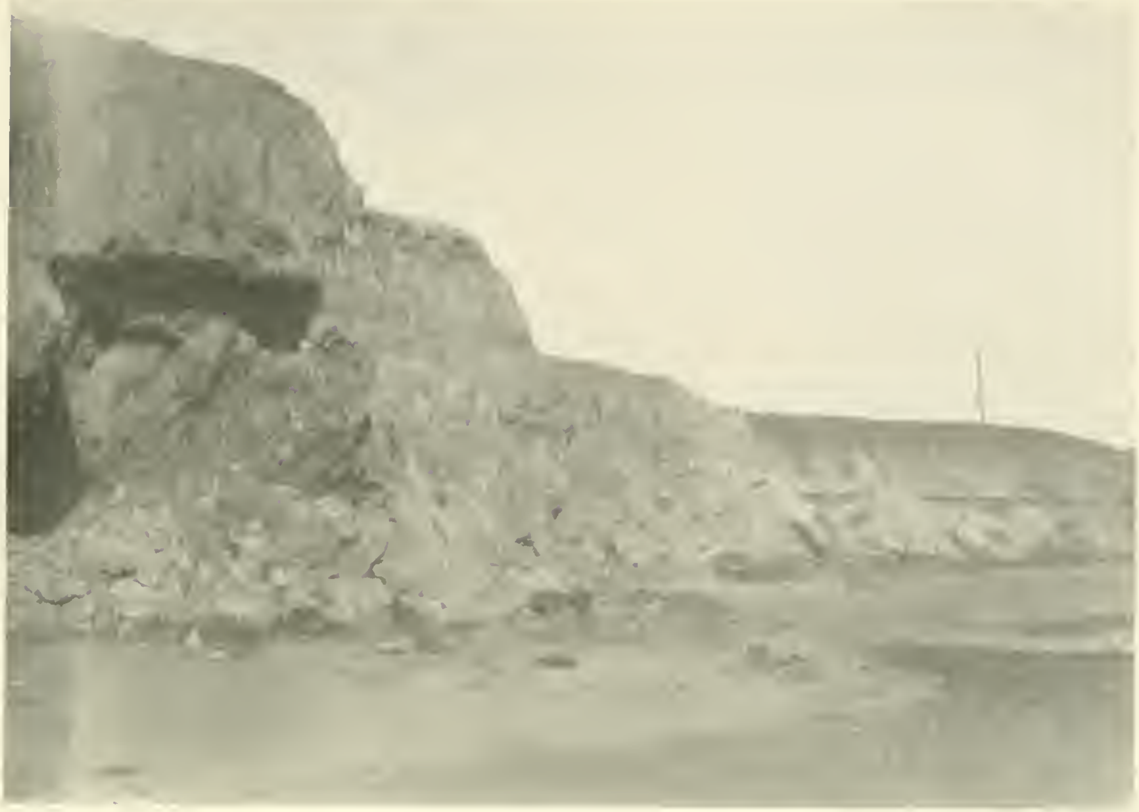


Figure a. San Diego.—Bluff at foot of Twenty-sixth street, looking north, showing the fossiliferous upper San Pedro (Pleistocene) deposits in the lower half of the bluff. The Anomia limatula bed is at the very base of the bluff and forms the reefs at the right of the picture.

Photograph by R. Arnold.

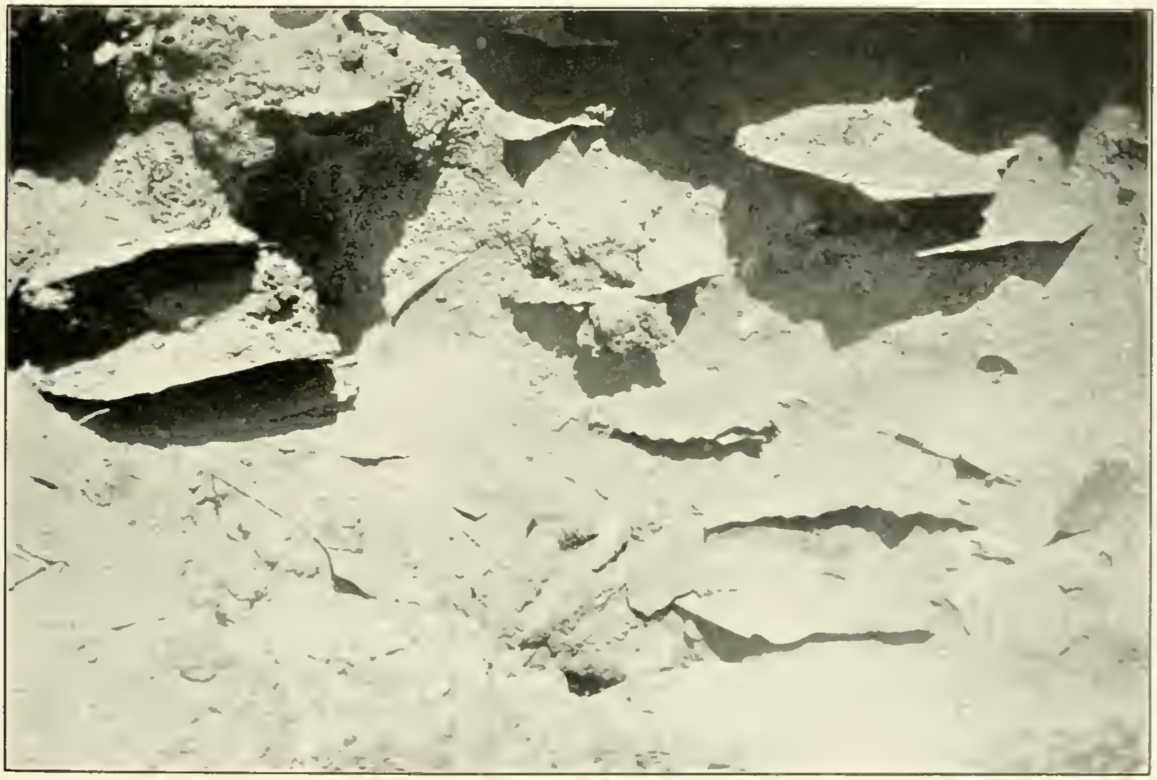


Figure b. San Diego.—Small section of the sea-cliff at Pacific Beach, showing Pecten expansus and Opalia varicostata in the matrix of the San Diego formation (Pliocene).

Photograph by R. Arnold.

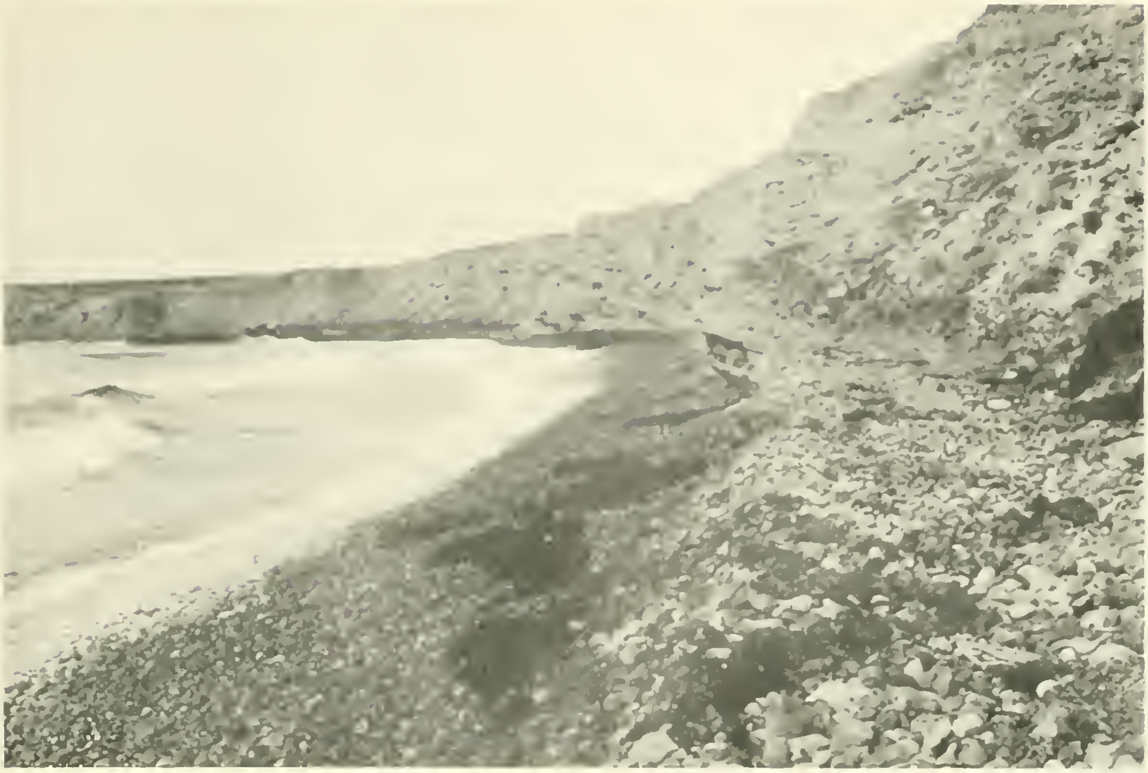


Figure a. San Diego.—Sea-cliff at Pacific Beach, looking north, showing the base of the slightly tilted sandstone of the San Diego formation (Pliocene), resting on massive gravels and conglomerates.

Photograph by R. Arnold.

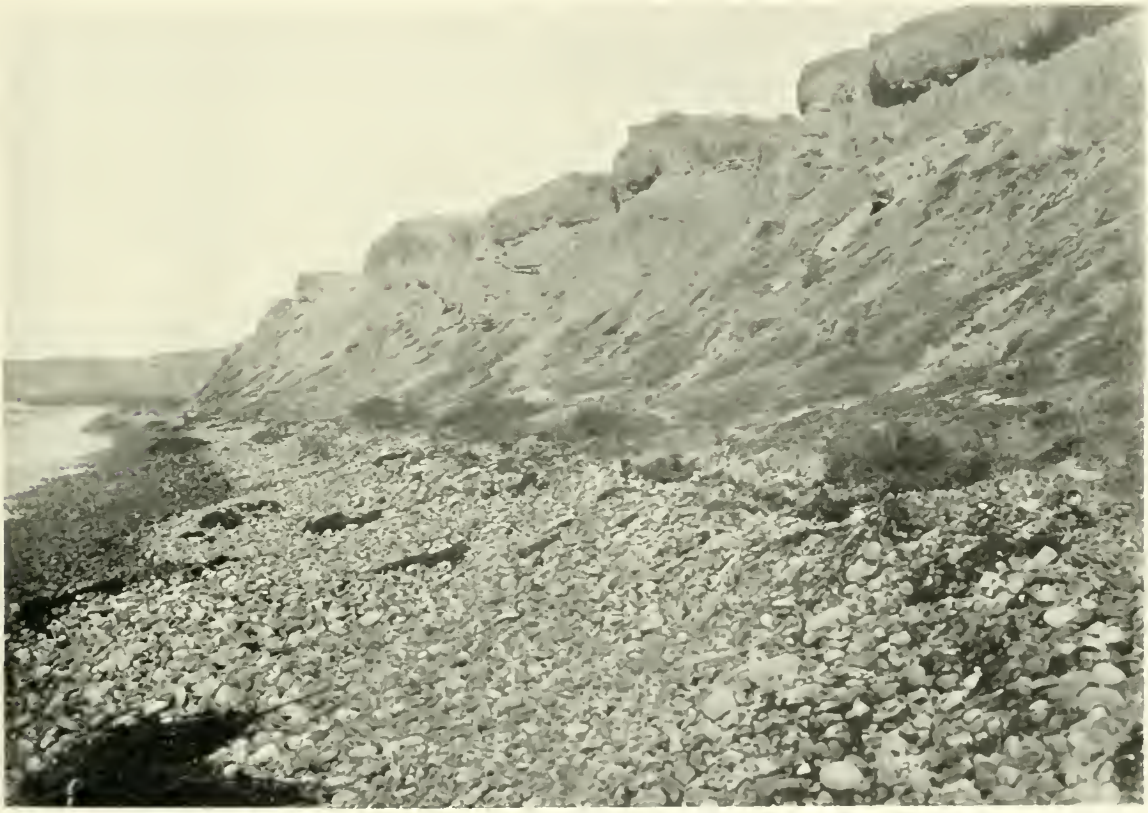


Figure b. San Diego.—Sea-cliff at Pacific Beach, looking north from a point one-half mile north of Ocean Front, showing slightly tilted sandstones of the San Diego (Pliocene) formation capped by horizontal upper San Pedro (Pleistocene) gravels.

Photograph by R. Arnold.

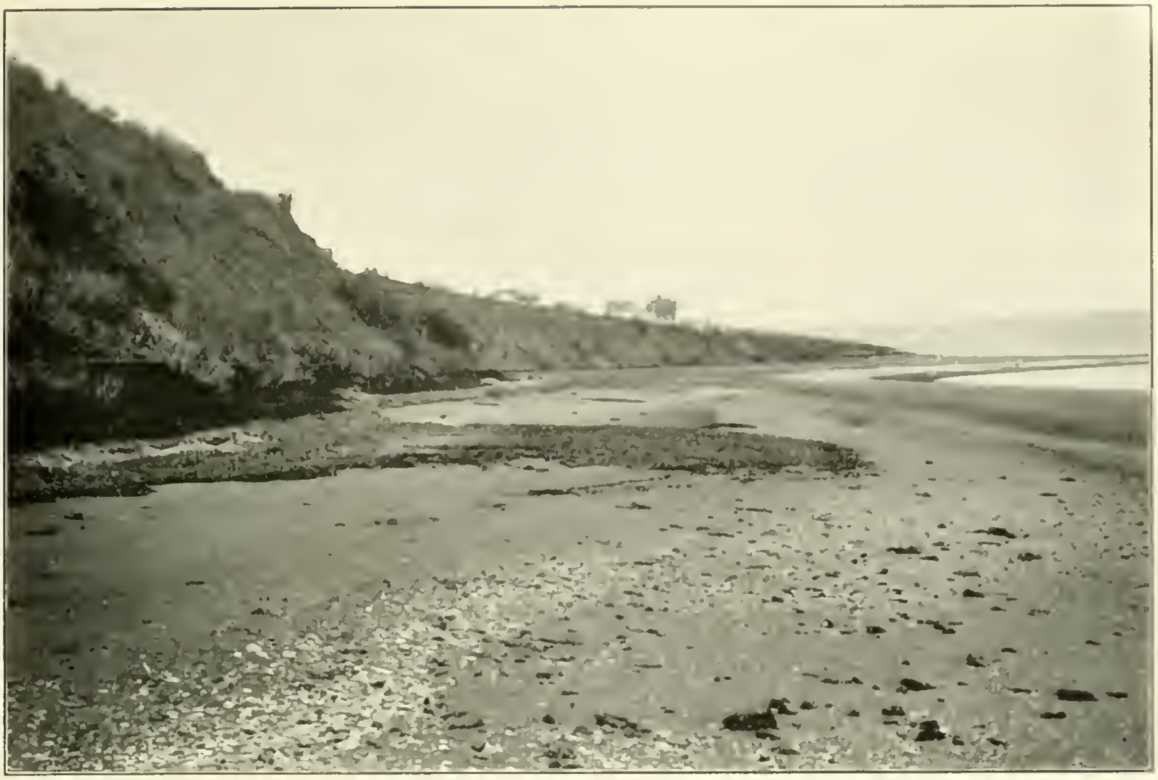


Figure a. San Diego.—Bluff and beach at Spanish Bight, looking north, showing the very fossiliferous layer at the base of the bluff which also forms the beach at this point.

Photograph by R. Arnold.

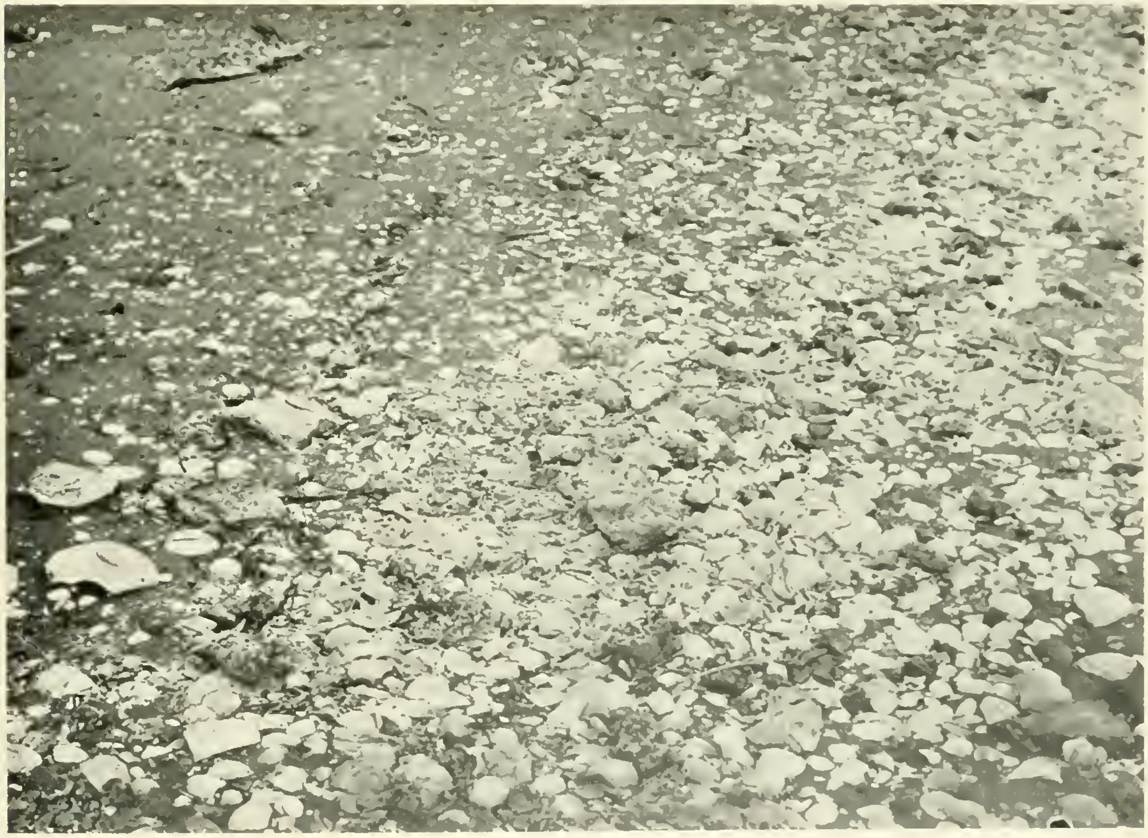


Figure b. San Diego.—A closer view of the beach at Spanish Bight. Most of the shells seen in this picture are in place in the hard Pleistocene sand layer which forms the beach at this point.

Photograph by R. Arnold.

Index to Volume III.

New generic, specific and subspecific names in **heavy-faced type**; synonyms in *italics*

- ACILA 72, 95
  - *castrensis* 72, 95, 138
  - *lyalli* 95
- Acmæa 84, 317
  - depicta 25, 39, 84, 317
  - insessa 15, 19, 22, 23, 25, 27, 31, 39, 52, 60, 84, 318
  - instabilis 25, 39, 84, 318
  - mitra 25, 39, 84, 197, 317, 318
  - paleacea 25, 39, 84, 317, 319
  - pelta 19, 27, 31, 33, 39, 55, 60, 84, 319
  - spectrum 19, 23, 27, 33, 39, 84, 320
- Acmæidæ 84, 317
- Actæon 77, 188
  - punctocœlata 19, 22, 27
  - (Rictaxis) punctocœlata 39, 55, 60, 189
  - traskii 27, 39, 60, 77, 188, 189
- Actæonidæ 77, 188
- Acus 78, 198
  - simplex 78, 198
- Adesmacea 77, 183
- Admete 79, 219
  - gracilior 19, 39, 52, 79, 219
  - viridula 219
- Æsopus 80, 237
  - chrysalloidea 80, 237, 238
  - japonicus 237
  - **oldroydi** 80, 238
- *Akera culcitella* 190
- *Aletes squamigerus* 299
- Aligena 74, 138
  - **cerritensis** 30, 35, 74, 138
  - striata 138
- Amaltheidæ 83, 311
- Amaura 82, 282
  - candida 282
  - nuciformis var. avellana 82, 283
  - pupiformis 82, 283
- Amauropsis 282
- Amiantis 59, 75, 145
  - *callosa* 27, 30, 35, 57, 59, 60, 75, 145
- *Amphidesma decisa* 165
  - *pulchra* 166
- Amphissa 80, 241
  - bicolor 242
  - corrugata 15, 19, 25, 27, 31, 39, 52, 80, 237, 241, 242
  - *tuberosa* 240
  - **ventricosa** 19, 39, 80, 242
  - versicolor 19, 23, 25, 27, 31, 39, 60, 80, 242
- *Amusium caurinum* 107
- *Amycla carinata* 240
  - *chrysalloidea* 237
  - *gausapata* 239
- *Amycla tuberosa* 240
- Anachis 80, 237
  - **minima** 80, 237
  - rugosa 237
- Anatinacea 73, 121
- Angulus 75, 157
  - bodegensis 75, 158
  - buttoni 18, 21, 23, 25, 27, 30, 35, 55, 75, 157, 158
  - idæ 75, 158
  - *modestus* 157
    - var. *obtusus* 157
  - rubescens 75, 159
- Anomalodesmacea 73, 121
- Anomia 59, 73, 117
  - ephippium 117
  - lampe 18, 21, 25, 27, 30, 32, 35, 55, 56, 60, 73, 117, 118
  - limatula 59, 60, 73, 117, 118
  - *macroschisma* 116
- Anomiacea 73, 116
- Anomiidæ 73, 116
- Anthozoa 46, 71, 86
- Arca 16, 72, 101, 102
  - glycymeris 100
  - labiata 27, 35, 67, 72, 101
  - noæ 101
  - nucleus 95
  - sulcicosta 57
- Arcacea 72, 100
- Arcidæ 72, 100
- Arcinæ 72, 101
- *Arcopagia medialis* 160
- *Artemis ponderosa* 146
- Arthropoda 85, 344
- Arthropomata 71, 92
- Astartacea 73, 127
- Astarte 73, 127
  - **branneri** 27, 30, 60
  - (Crassinella) **branneri** 35, 127
  - compacta 127
  - obliqua 127
  - semisulcata 127
- Astartidæ 73, 127
- *Astralium inæquale* 321
- Astyris 80, 238
  - californiana 80, 238
  - *chrysalloidea* 237
  - clausiliæforme 238
  - *gausapata* 56, 80, 238, 239, 240
    - var. *carinata* 80, 240
  - *tuberosa* 80, 240
- Auriculidæ 78, 196

Axinea barbarensis 100
  intermedia 100

BALANIDÆ 85, 344
Balanus 85, 344
  concavus 22, 24, 25, 28, 31, 32, 47, 52, 55, 60, 85, 344
  cylindraceus var. *concavus* 344
Bela 78, 209, 210
  fidicula 15, 19, 25, 39, 52, 55, 78, 209, 210
  sanctæ-monicæ 19, 39, 56, 78, 210
  sculpturata 214
Bittium 82, 291
  asperum 15, 17, 19, 25, 27, 39, 52, 55, 56, 60, 82, 291, 293, 294
  californicum 19, 39, 82, 291
  (*Elachista*) *californicum* 291
  filosum 19, 22, 25, 27, 39, 82, 292, 293, 294
  orthochila 295
  quadrifilatum 19, 22, 23, 25, 28, 31, 39, 52, 82, 292, 293, 294
  reticulatum 291
  rugatum 19, 22, 23, 25, 28, 31, 39, 82, 290, 295
  (Styliferina) tenuisculpta 296
  williamsoni 28, 39, 60, 82, 292, 295
Boreotrophon 80, 249
  cerritensis 80, 249
  gracilis 80, 250
  multicostatus 80, 251
  orpheus var. **præcursor** 80, 250, 251, 253
  pedroana 80, 251
  scalariformis 80, 252
  stuarti 80, 252
  tenuisculptus 80, 253
  triangulatus 80, 254
Bornia 74, 136
  corbuloides 136
  retifera 18, 35, 74, 136
Borsonia 78, 200
  bartschi 78, 200, 207
  dalli 78, 200, 201
  hooveri 78, 200, 201
Brachiopoda 15, 46, 71, 92
Brachyura 85, 345
Bryozoa 46, 52, 71, 92
Buccinidæ 79, 227
Buccinum corrugatum 241
  fossatum 232
Bulla 77, 193
  adamsii 193
  ampulla 193
  (*Tornatina*) *cerealis* 189
  (*Akera*) *culcitella* 190
  nebulosa 33, 193
  punctata 193
  punctulata 23, 25, 28, 31, 39, 67, 77, 193
  quoyi 28, 39, 77, 193
  virescens 194
Bullidæ 77, 193

CADULUS 77, 187
  fusiformis 187
  nitentior 19, 47, 55, 60, 77, 187
  subfusiformis 187
Cæcidæ 82, 297
Cæcum 83, 297
  californicum 19, 22, 28, 31, 39, 83, 297, 298
  cooperi 297
  cornuoides 297
  crebricinctum 19, 22, 25, 28, 31, 39, 83, 297, 298
  magnum 19, 22, 39, 83, 298
Calliostoma 84, 329
  annulatum 28, 39, 84, 329
  canaliculatum 15, 19, 22, 23, 25, 28, 31, 33, 39, 60, 84, 329
  costatum 19, 22, 25, 28, 31, 39, 60, 84, 330
  gemmulatum 25, 28, 31, 39, 52, 60, 84, 330
  tricolor 15, 22, 23, 25, 28, 31, 39, 60, 84, 331
  zizyphinum 329
Calliostomæ 328
Callista 74, 143
  (Amiantis) callosa 145
  newcombiana 35, 59, 60, 74, 143
  subdiaphana 15, 17, 35, 74, 144, 145
    var. **pedroana** 18, 35, 74, 144
Calyptræa echinus 308
  fastigiata 307
  hystrix 308
  mamillaris 307
  spinosa 306
Calyptræidæ 83, 306
Cancellaria 79, 217
  cancellata 217
  cassidiformis 218
  cooperi 28, 39, 79, 217
  (*Narona*) *cooperi* 217
  crawfordiana 28, 39, 217
  gracilior 219
  tritonidea 28, 39, 55, 67, 78, 218
  vetusta 218
Cancellariidæ 79, 217
Cancer 60, 85, 345
  breweri 20, 47, 85, 345
  magister 345
Cancrini 85, 345
Cancroidea 85, 345
Capulus tumens 313
Cardiacea 74, 138
Cardiidæ 74, 138, 141
Cardita monilicosta 128
  occidentalis 128
  sublenta 128
  ventricosa 128
Carditidæ 73, 128
Carditacea 73, 128
Cardium 74, 138
  californicum 140
  californiense 68
  centifilosum 142
  corbis 18, 21, 23, 25, 27, 30, 35, 52, 68, 140

- Cardium (Cerastoderma) corbis 140
  - edule 140
  - elatum 27, 30, 35, 67, 141
  - (Lævicardium) elatum 141
  - hillanum 142
  - isocardia 138
  - *luteolabrum* 139
  - *modestum* var. *centifilosum* 142
  - norvegicum 140
  - *nuttalli* 140
  - *panamense* 56, 139
  - procerum 18, 27, 30, 32, 35, 56, 59, 60, 139
  - (Ringicardium) procerum 139
  - quadrigenarium 27, 30, 32, 35, 60
  - (Trachycardium) quadrigenarium 139
  - ringens 139
  - substriatum 141
  - (Lævicardium) substriatum 141
- Caryophyllia 71, 86
  - arnoldi 46, 71, 86, 87, 88
  - **californica** 46, 71, 87, 88
  - **pedroënsis** 46, 71, 87, 88
- Cerastoderma 74, 140
  - corbis 74, 140
- Cerithiacea 82, 290
- Cerithidea 82, 296
  - californica 15, 19, 22, 23, 25, 28, 31, 33, 40, 60, 82, 296, 297
  - decollatum 296
  - *sacrata* 297
- Cerithiidæ 82, 291
- Cerithiopsidæ 82, 290
- *Cerithiopsis assimilata* 290
- *Cerithium californicum* 296
  - *filosum* 292
  - (*Potamis*) *sacratum* 296
- *Cerostoma foliatum* 245
  - *nuttalli* 245
- Chama 74, 130
  - exogyra 27, 30, 35, 74, 130
  - lazarus 130
  - pellucida 15, 18, 23, 25, 27, 30, 35, 74, 130
  - *spinosa* var. *pellucida* 130
- Chamacea 73, 130
- Chamidæ 130
- *Chemnitzia cribrifilata* 276
  - *gibbosa* 279
  - *muricata* 270
  - *similis* 270
  - *subcuspidata* 277
  - *tenuicula* 275
  - *torquata* 271
    - var. *stylina* 272
  - *tridentata* 273
    - var. *aurantia* 272
- Chicoreus 80, 243
  - leeanus 80, 243
  - trialatus 80, 243
- Chione 75, 147
  - *brevilineata* 149
- *Chione callosa* 147
  - *californiensis* 149
  - *ductifraga* 60, 75, 147
  - *gnidia* 75, 147
  - neglecta 75, 148
  - *nuttalli* 149
  - *simillima* 32, 56, 60, 75, 148
  - *succincta* 33, 55, 56, 60, 75, 148, 149
- *Chiton amiculatus* 342
  - *californicus* 342
  - *muscosus* 343
  - *regularis* 342
  - *sitkensis* 342
  - *stelleri* 342
  - (*Cryptochiton*) *stelleri* 342
- Chitonidæ 85, 342
- Chlamys 72, 107, 109
  - hastatus 72, 109
  - hericeus 72, 110
    - var. strategus 72, 110
  - **jordani** 72, 111
  - latiauritus 72, 111
    - var. fucicolus 112
    - var. **fragilis** 72, 112
    - var. monotimeris 72, 112
  - opuntia 72, 113
- Chlorostoma 84, 324
  - argyrostoma 324
  - aureotinctum 28, 40, 84, 324
  - brunneum 15, 23, 25, 40, 50, 84, 324
  - funebrale 19, 22, 23, 25, 28, 31, 32, 33, 40, 55, 60, 84, 325
    - var. subapertum 19, 22, 23, 25, 28, 31, 40, 84, 325
  - gallina 23, 25, 28, 40, 60, 84, 326
  - *marcidus* 328
  - *montereyensis* 326
  - montereyi 15, 19, 23, 25, 28, 40, 60, 84, 325, 326, 328
  - *pfeifferi* 326
  - *pulligo* 328
  - subapertum 23
  - (Omphalius) viridulum var. ligulatum 19, 22, 23, 25, 28, 31, 40, 327
  - viridulus 327
- Chorus 80, 247
  - belcheri 25, 28, 31, 40, 55, 80, 247
- Chrysallida 82, 281, 283
  - communis 283
  - **diegensis** 82, 284
- Chrysodomus 15, 40, 79, 227, 229
  - antiqua 227
  - dirus 229
  - rectirostris 15, 19, 25, 40, 79, 228
  - tabulatus 15, 17, 19, 22, 40, 52, 55, 67, 79, 228
- Cirripedia 85, 344
- Clathurella 78, 210
  - canfieldii 211
  - *conradiana* 15, 19, 22, 28, 40, 52, 78, 210
- Clavatula 210

Clementia subdiaphana 144
Clidiophora 73, 124
  claviculata 124
  punctata 18, 27, 35, 60, 73, 124
Clypeastroida 71, 91
Clypidella 85, 339
  bimaculata 19, 22, 28, 31, 40, 60, 85, 339
  callomarginata 19, 22, 25, 28, 31, 40, 85, 339, 340
  pustulata 339
Cœlenterata 71, 86
Columbella 80, 236
  californiana 19, 22, 238, 239
  (Astyris) californiana 40, 238
  carinata 240
  chrysalloidea 19, 22, 28, 237
  (Æsopus) chrysalloidea 40, 60, 237
  gausapata 15, 17, 19, 22, 23, 25, 28, 31, 33, 239, 240
    var. carinata 15, 17, 19, 22, 23, 25, 28, 31, 32, 33, 239
  (Astyris) gausapata 40, 52, 55, 60, 239
    var. carinata 40, 52, 55, 60, 240
  mercatoria 236
  minima 28
  (Anachis) **minima** 48, 237
  oldroydi 19
  (Æsopus) **oldroydi** 40, 238
  solidula 80, 236, 237
    var. **præcursor** 28, 40, 236
  tuberosa 19, 22, 23, 25, 28, 31, 239, 240
  (Astyris) tuberosa 40, 52, 60, 240
Columbellidæ 80, 236
Cominella (Amphissa) corrugata 241
Conchocele bisecta 135
  disjuncta 135
Concholepas antiquatus 312
Conidæ 78, 199
Conus 78, 199
  californicus 15, 17, 19, 22, 23, 25, 28, 31, 32, 33, 40, 60, 78, 197, 199
  marmoreus 199
  ravus 199
Cooperella 75, 153
  subdiaphana 18, 35, 61, 75, 153
Cooperellidæ 75, 153
Coralliophila 81, 262
  neritoidea 262
  nux 28, 40, 81, 262
Coralliophilinæ 81, 262
Corbula 76, 180
  gallica 180
  luteola 15, 18, 21, 27, 30, 35, 61, 76, 181
Corbulidæ 76, 180
Crassinella 73, 127
  branneri 73, 127
Crepidula 83, 307
  aculeata 19, 22, 28, 40, 68, 83, 308
  adunca 19, 22, 24, 28, 31, 40, 52, 55, 56, 61, 83, 308, 311
  californica 308
Crepidula convexa 308
  dorsata 19, 25, 31, 40, 83, 309
  excavata 57
  explanata 310
  grandis 24, 40, 58, 61, 68, 83, 309, 310
  navicelloides 19, 22, 24, 25, 28, 31, 40, 52, 83, 310
  nummaria 310
  onyx 19, 22, 24, 28, 31, 40, 61, 83, 310, 311
    var. *rugosa* 311
  peruviana 307
  prærupta 309
  princeps 309
  rostriformis 308
  rugosa 19, 24, 25, 28, 31, 32, 33, 40, 50, 83, 311
Crucibulum 83, 306
  auricula var. *spinosum* 306
  dumosum 306
  rudis 306
  spinosum 22, 23, 24, 25, 28, 31, 32, 33, 40, 56, 61, 83, 306
Crustacea 20, 22, 24, 25, 28, 31, 47, 85, 344
Crypta adunca 308
  dorsata 309
Cryptochiton 85, 342
  stelleri 15, 19, 40, 68, 85, 342
Cryptodon bisectus 135
  flexuosus 135, 136
  nuttalli 178
Cryptodontidæ 74, 135
Cryptomya 76, 179
  californica 18, 21, 23, 25, 27, 30, 32, 33, 35, 55, 61, 76, 179, 180
  ovalis 180
Cryptonatica 83, 313
  clausa 83, 313
Ctenobranchiata 78, 198
Cumingia 76, 167
  californica 15, 18, 21, 23, 25, 27, 35, 76, 167
  mutica 167
  similis 167
Cupulifera 92
Cyclas acutilineata 131
Cyclostrematidæ 85, 335
Cylichna 77, 192
  alba 19, 28, 41, 55, 61, 68, 77, 191, 192
  arachis 192
  cylindracea 67, 192
Cypræa 82, 288
  argus 288
  spadicea 24, 41, 82, 288
Cypræidæ 82, 288
Cypricardia pedroana 155
Cyprina bisecta 135
Cythara 78, 211
  branneri 19, 41, 52, 78, 211
Cytherea 142
  callosa 145
  crassatelloides 143
  (*Tivela*) *crassatelloides* 143
  (*Trigonella*) *crassatelloides* 143

- Cytherea erycina 143
  - gigantea 146
  - *solidissima* 143
  - *stultorum* 143

- DAPHNELLA 210
  - *filosa* 223
  - *interfossa* 213
- Decapoda 85, 345
- Delphinoidea 84, 320
  - cancellata 320
  - **coronadoensis** 61, 84, 320
- *Dendropoma lituella* 299
- Dentaliidæ 77, 185
- Dentalium 77, 185
  - elephantinum 185
  - hexagonum 19, 22, 24, 25, 28, 31, 32, 47, 55, 61, 68, 77, 185
  - indianorum 19, 22, 25, 47, 77, 186, 187
  - *neohexagonum* 185, 186
  - *pretiosum* var. *indianorum* 186
  - pseudohexagonum 19, 28, 47, 61, 77, 186
  - semipolitum 24, 25, 28, 47, 77, 187
  - *semistriatum* var. *semipolitum* 187
- Diadematoida 71, 90
- Diastoma 19, 41, 52, 82, 296
- Dione angustiformis 144
  - *nobilis* 145
- Diplodonta 74, 133
  - lupinus 133
  - orbella 18, 25, 27, 35, 61, 74, 133, 134
  - sorricata 27, 35, 61, 74, 134
- Diplodontidæ 74, 133
- *Dispotæa dumosa* 306
- Ditremata 78, 196
- Docoglossa 84, 317
- Dolichotoma 78, 202
  - carpenteriana 78, 202
  - cooperi 78, 203
  - tryoniana 78, 203
- Donacidæ 76, 169
- Donax 76, 157, 169, 171
  - californica 18, 21, 27, 35, 76, 170, 171
  - *californicus* 170, 171
  - *flexuosus* 170
  - lævigata 18, 21, 23, 25, 27, 30, 32, 33, 35, 55, 59, 61, 76, 170, 171
  - *navicula* 170
  - *obesus* 170
  - *stultorum* 143
  - trunculus 169
- Dosinia 16, 146
  - *callosa* 145
  - discus 146
  - ponderosa 59, 61, 146
- Dosininæ 75, 146
- Drillia 78, 204, 212
  - cancellata 19, 31, 41, 61, 78, 204, 205
  - hemphilli 19, 22, 28, 31, 41, 55, 61, 78, 204, 207
  - incisa 61, 78, 205
  - inermis 19, 28, 31, 41, 55, 61, 68, 78, 204, 205, 206
    - var. penicillata 19, 22, 24, 25, 28, 31, 32, 33, 41, 55, 61, 205
  - **johnsoni** 28, 41, 78, 206
  - **merriami** 15, 19, 41, 78, 207
  - mœsta 200
  - montereyensis 19, 41, 78, 207
  - pallida 207
  - *penicillata* 78, 205
  - perversa 208
  - pudica 28, 41, 78, 208
  - **renaudi** 78, 208
  - torosa 15, 17, 19, 22, 24, 25, 28, 31, 41, 78, 100, 207, 208, 209
- *Dunkeria laminata* 277

- ECHINARACHNIUS 71, 91
  - *excentricus* 20, 22, 24, 25, 28, 31, 46, 53, 55, 57, 58, 61, 71, 91
- Echinometridæ 71, 90
- Echinoidea 20, 22, 24, 25, 28, 31, 46, 71, 90
- Echinodermata 71, 90
- *Echinus purpuratus* 90
- *Elachista californicum* 291
- Elasmobranchii 85, 346
- Emarginulinæ 85, 337
- Eochitonia 85, 342
- Epiphragmophora 77, 194
- Erato 82, 289
  - columbella 28, 41, 82, 289
  - lævis 289
- Eucrustacea 85, 344
- Euechinoidea 71, 90
- Eulima 81, 268
  - falcata 19, 41, 81, 268, 269
  - hastata 19, 28, 41, 55, 61, 81, 268, 269
  - micans 19, 22, 25, 28, 31, 41, 55, 61, 81, 268, 269
  - tortuosa 268
- Eulimidæ 81, 268
- Eupleura 80, 248
  - caudata 248
  - muriciformis 19, 24, 28, 41, 61, 67, 80, 248, 249
    - var. **curta** 28, 41, 80, 249
    - var. pleistocenensis 249
    - var. *unispinosa* 248, 249
- Evalea 82, 281
  - *æquisculpta* 284
  - elegans 281
  - gouldii 82, 282
  - **stearnsii** 82, 282

- FASCIOLARIIDÆ 79, 224
- Fissurella 85, 340
  - *aspera* 338, 340
  - *crenulata* 337
  - *inæqualis* 338
    - var. *pica* 338
  - *pica* 338
  - *picta* 340
  - volcano 19, 22, 24, 25, 28, 31, 33, 41, 61, 85, 340

Fissurellidæ 85, 337
Fissurellidæa bimaculata 339
    callomarginata 340
Fissurellidinæ 85, 337
Fissuridea 85, 337
    aspera 19, 22, 24, 25, 28, 31, 41, 85, 338, 339
    inæqualis 24, 28, 31, 32, 41, 85, 337, 338
    murina 19, 24, 25, 28, 31, 41, 85, 339
Fossaridæ 83, 304
Fossarus 83, 304
    costatus 304
    (Isapis) fenestrata 304
Frenula jeffreysi 93
Fusinæ 79, 224
Fusus, 79, 224
    umbustus 225, 226, 227
    barbarensis 15, 17, 19, 24, 25, 28, 41, 79, 224, 225
    cancellinus 257
    corpulentus 224
    dupetithouarsi 224
    fidicula 209
    geniculus 225
    kobelti 226
    luteopictus 19, 24, 25, 28, 31, 41, 79, 225
    nicobaricus 224
    oregonensis 286
    robustus 19, 24, 25, 28, 41, 52, 79, 219, 224, 225, 226, 227
    rugosus 19, 41, 79, 224, 225, 226, 227
    scalariformis 252

GADINIA 78, 197
    afra 197
    radiata 197
    (*Rowellia*) *radiata* 197
    reticulata 41, 78, 197
        var. *radiata* 197
Gadiniidæ 78, 197
Galerus 83, 307
    chinensis 307
    contortus 307
    mammillaris 19, 22, 25, 28, 41, 52, 83, 307
Gastropoda 15, 17, 19, 22, 23, 25, 27, 31, 33, 39, 77, 188
Gemminæ 75, 152
Genota 78, 202
    carpenteriana 202
Gibbula optabilis 332
    parcipicta 333
Glottidia 71, 94
    albida 52, 71, 94
Glycymeris 72, 100
    barbarensis 23, 25, 27, 30, 35, 61, 72, 100, 101
    estrellana 182
    generosa 182
    intermedia 101
    septentrionalis 23, 25, 27, 30, 32, 36, 72, 100, 101
Glyphis aspera 338
    densiclathrata 339
        var. *murina* 339
Glyphis inæqualis 338
Gymnoglossa 81, 268

HALIOTIDÆ 68, 69, 85, 336
Haliotis 33, 49, 50, 68, 85, 336, 337
    cracheroidii 33, 336
    fulgens 24, 34, 41, 61, 85, 336, 337
    gigantea 336
    rufescens 336
    splendens 336
Haminea 77, 194
    cymbiformis 194
    hydatis 194
    virescens 28, 41, 77, 194
Helicidæ 77, 194
Helix 28, 77, 194
    cuyana 194
    (Epiphragmophora) 41, 195
Hinnites 72, 115
    cortezi 115
    crassus 115
    giganteus 21, 23, 27, 30, 36, 72, 115
    poulsoni 115
Hipponyx 83, 311, 312
    antiquatus 15, 19, 41, 83, 102, 312, 313
    cornucopiæ 311
    cranioides 19, 22, 24, 31, 41, 61, 83, 312
    mitrula 102, 312
    tumens 19, 22, 24, 41, 61, 83, 312, 313
Hydrobiinæ 83, 305
Hygrophila 77, 195

ISAPIS 83, 304
    anomala 304
    fenestrata 19, 22, 24, 25, 28, 42, 83, 304
Ischnochiton 85, 342
    longicymoa 342
    regularis 28, 42, 85, 342
Ismenia jeffreysi 93
Isopleura 85, 342
Ivara 82, 285
    terricula 19, 42, 82, 285

JANIRA *bella* 103, 104, 105
    dentata 104, 105, 106
    excavata 104
Jonannetinæ 77, 184

KELLIA 74, 136, 154
    laperousii 15, 18, 21, 36, 61, 74, 136, 137
    suborbicularis 18, 21, 36, 68, 74, 137
Kelliellidæ 74, 138
Kennerlia 73, 123
    bicarinata 18, 36, 73, 123
    filosa 18, 36, 73, 123, 124

LABIOSA 76, 177
    (Ræta) undulata 177
Lacuna, 83, 302, 321
    carinata 303
    compacta 19, 28, 31, 42, 52, 55, 61, 83, 302, 303

Lacuna pallidula 302
  porrecta 19, 22, 24, 25, 28, 31, 42, 83, 303
  solidula 19, 28, 42, 61, 83, 303
    var. *compacta* 302
Lævicardium 74, 140
  elatum 74, 141
  substriatum 18, 21, 23, 25, 27, 30, 33, 36, 61, 74, 141
Lamellaria 84, 317
  depressa 317
  perspicua 317
  stearnsii 19, 42, 61, 84, 317
Lamellariidæ 84, 317
Lancea 81, 272
  aurantia 81, 272
  elongata 272
  pentalopha 81, 274
  tridentata 81, 273
Laqueus 71, 93
  californicus 93, 94
    var. *vancouverensis* 93
  jeffreysi 15, 46, 51, 52, 53, 71, 93
Lazaria 74, 129
  pectunculus 129
  subquadrata 18, 21, 25, 27, 36, 74, 129
Leda 57, 72, 96
  calata 98
  fossa 18, 36, 72, 96
  hamata 18, 36, 61, 72, 97
  minuta var. **præcursor** 18, 21, 36, 72, 97
  pernula 96
  taphria 15, 17, 18, 21, 23, 25, 27, 31, 32, 36, 61, 72, 98
Ledidæ 72, 96
Lepas tintinnabulum 344
Leptonacea 74, 136
Leptonidæ 74, 136
Leptonyx bacula 323
  sanguinea 323
Leptothyra 84, 322, 323
  bacula 19, 31, 42, 52, 84, 323, 324
  carpenteri 19, 22, 25, 28, 42, 68, 84, 322, 323, 324
  paucicostata, 19, 42, 52, 84, 323
  sanguinea 323
  sanguineus 323
Leucosyrinx 78, 202
  pedroana 78, 202, 208
Lima 73, 115
  dehiscens 18, 36, 116
  (Mantellum) dehiscens 116
  hians 115
  orientalis 116
  squamosa 115
Limidæ 73, 115
Limnæidæ 77, 195
Lingula albida 94
Lingulidæ 71, 94
Lingulinæ 71, 94
Liocardium cruentatum 141
  elatum 141
Liocardium substriatum 141
Lioconcha newcombiana 143
Liotiidæ 84, 320
Lithophaga 73, 121
  plumula 73, 121
Lithophagus plumula 31, 36, 121
Littorina 83, 301
  litorea 301
  patula 301
  pedroana 303
  planaxis 15, 19, 22, 28, 42, 83, 301
  plena 302
  scutulata 19, 22, 24, 25, 28, 31, 32, 42, 55, 61, 83, 301, 302
Littorinidæ 83, 301
Lucapina 85, 337
  crenulata 31, 42, 85, 337
Lucapinella callomarginata 340
Lucinidæ 74, 131
Lucina 74, 131
  acutilineata 14, 15, 17, 18, 21, 23, 25, 27, 36, 52, 61, 65, 67, 68, 74, 131, 132
  borealis 67, 131
  californica 15, 18, 21, 23, 25, 27, 31, 32, 33, 36, 52, 56, 62, 74, 132
  jamaicensis 131
  nuttalli 18, 21, 23, 25, 27, 31, 32, 33, 36, 62, 74, 132
  orbella 134
  tenuisculpta 27, 36, 61, 74, 133, 134
  tetrica 131
Lucinacea 74, 131
Lunatia 84, 315
  lewisii 32, 50, 57, 84, 315
Luponia spadicea 288
Lutraria canaliculata 177
  capax 178
  maxima 178
  (*Cryptodon*) *nuttalli* 178
  transmontana 177, 178
  undulata 177
  ventricosa 175
Lutrariinæ 76, 178
Lutricola alta 160
Lyonsia 73, 125
  bracteata 125
  californica 15, 18, 21, 23, 25, 27, 36, 73, 125
  nitida 125
  norvegica 125
Lyonsiidæ 73, 125

MACHÆRA *patula* 173
Macoma 52, 75, 160, 161, 169
  calcarea 18, 36, 75, 161
  edulis 68
  expansa 161
  indentata 27, 31, 36, 62, 75, 161, 163
  inquinata 15, 18, 23, 25, 27, 31, 33, 36, 48, 56, 62, 68, 75, 162, 163
  kelseyi 161, 162, 163, 164

- Macoma nasuta 18, 21, 23, 25, 27, 31, 32, 33, 36, 55, 57, 62, 68, 75, 162. 163, 164, 167
    - var. kelseyi 27, 31, 36, 62, 75, 164
  - *pedroana* 157
  - secta 18, 21, 23, 25, 27, 31, 32, 33, 36, 62, 68, 75, 163, 164
  - (*Rexithærus*) *secta* var. *edulis* 164
  - tenera 160, 161
  - *tersa* 163
  - yoldiformis 18, 21, 36, 62, 75, 161, 163, 165
- Macron 79, 230
  - kellettii 28, 42, 79, 230
  - lividus 42, 79, 230
- Mactra 76, 164, 174
  - anatina 177
  - californica 27, 36, 59, 62, 76, 174, 175, 176
  - catilliformis 23, 25, 27, 31, 33, 55
  - (Spisula) catilliformis 36, 62, 176
  - exoleta 27, 36, 62, 67, 76, 175
  - falcata 18, 21, 23, 25, 27, 31, 33, 176
  - (Spisula) falcata 36, 62, 176
  - hemphilli 27, 36, 76, 175
  - *maxima* 178
  - planulata 174
    - var. *falcata* 176
  - solida 175
  - stultorum 174
- Mactracea 76, 174
- Mactridæ 76, 174
- Mactrinæ 76, 174
- *Mœra salmonea* 157
- Malacostraca 85, 345
- Mangilia 55, 78, 210, 211
  - angulata 10, 22, 25, 31, 42, 52, 55, 62, 78, 212
  - (Cythara) **branneri** 211
  - (Clathurella) conradiana 210
  - **hooveri** 28, 42, 78, 212
  - interfossa 213
    - var. **pedroana** 19, 25, 42, 52, 79, 213
  - interlirata 19, 31, 42, 79, 213
  - **oldroydi** 19, 42, 79, 213, 214, 215
  - **painei** 19, 42, 79, 214
  - sculpturata 15, 42, 79, 214, 215
  - striosa 28, 31, 42, 62, 79, 215
  - (Taranis) **strongi** 215
  - variegata 212
- Mangiliæ 214
- Mantellum 73, 115
  - dehiscens 73, 116
- Margarita 84, 332
  - *calostoma* 333
  - *cidaris* 334
  - helicina 332
  - optabilis 332, 333
    - var. **knechti** 22, 23, 28, 42, 84, 332, 333
    - var. **nodosa** 19, 22, 42, 84, 332
  - parcipicta 84, 333
    - var. **pedroana** 19, 22, 24, 28, 31, 42, 84, 333
  - pupilla 42, 52, 84, 333
- Margarita *salmonea* 333
- Marginella 79, 221
  - globella 221
  - jewettii 19, 22, 24, 25, 28, 42, 79, 221
  - (Volvarina) varia 222
- Marginellidæ 79, 221
- *Megatebennus bimaculatus* 339
- *Megerlia jeffreysi* 93
- Melampinæ 78, 196
- Melampus 78, 196
- Melampus luteus 196
  - olivaceus 19, 22, 24, 25, 28, 31, 42, 62, 78, 197
- Melania rufa 274
  - scalaris 277
- *Mercenaria perlaminosa* 146
- *Meretrix callosa* 145
- Metis 75, 160
  - alta 18, 23, 25, 27, 31, 36, 62, 75, 160
- Mitra 79, 222
  - episcopalis 222
  - maura 22, 24, 25, 28, 42, 79, 222
- Mitridæ 79, 222
- Mitromorpha 79, 223
  - aspera 223, 224
  - filosa 19, 42, 79, 223, 224
  - gracilis 223
  - **intermedia** 19, 42, 52, 79, 223
- *Modelia striata* 303
- *Modiola fornicata* 18, 31, 36, 52, 55, 120
  - *pulex* 118
  - *recta* 18, 23, 27, 31, 36, 62, 120
- Modiolus 73, 120
  - fornicatus 73, 120
  - rectus 73, 120
- Mœrella 75, 156
  - salmonea 18, 36, 75, 157
- Mollusca 72, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 95
- Molluscoidea 71, 92
- Monia 73, 116
  - macroschisma 73, 116
- Monoceros 80, 246
  - *brevidens* 247
  - engonatum 19, 22, 24, 25, 28, 31, 32, 42, 55, 56, 62, 80, 246, 247
    - var. spiratum 247
  - lapilloides 28, 42, 80, 246, 247
  - lugubre 246
  - *punctatum* 247
  - *unicarinatum* 246
- *Monodonta gallina* 326.
- Monotremata 77, 194
- Mopalia 85, 343
  - blainvillei 343
  - ciliata 28, 42, 85, 343
  - *muscosa* 343
- Mopaliidæ 85, 343
- *Mouretia reticulata* 197
- Murex 80, 243
  - adustus 243
  - *barbarensis* 254

Murex *belcheri* 247
    californicus 243, 246
    festivus 19, 24, 25, 28, 31, 244
    (Pteronotus) festivus 43, 244
    foliatus 28, 245
    (Pterorhytis) foliatus 43, 245
    foveolata 255
    leeanus 25, 28, 67
    (Chicoreus) leeanus 43, 243
    monoceros 28, 246
    (Cerostoma) monoceros 43
    (Pterorhytis) monoceros 246
    multicostatus 251
    nuttalli 244
    (Pterorhytis) nuttalli 43, 62, 245
    nux 262
    peritus 259
    tenuispina 243
    trialatus 24, 25, 28, 43, 243
    (Chicoreus) trialatus 243
    trigonulus 244
Muricidæ 80, 243
Muricidea barbarensis 254
    californica 243
    foveolata 255
    paucivaricata 246
    (*Phyllonotus*) *paucivaricata* 246
    perita 259
Mya abrupta 182
    cancellatus 179
    glycymeris 182
    norvegica 183
Myacea 179
Myacidæ 76, 179
Mysia 134
Mytilacea 73, 118
Mytilidæ 73, 118
Mytilimeria 73, 125
    nuttalli 15, 18, 21, 37, 73, 125, 126
Mytilus 73, 118, 126
    abbreviatus 118
    bifurcatus 119
    borealis 118
    californicus 50
    edulis 18, 23, 25, 27, 33, 36, 49, 68, 73, 118, 119
    incurvatus 118
    lithophagus 121
    minganensis 118
    modiolus 120
    notatus 118
    pedroanus 118
    pellucidus 118
    smaragdinus 118
    subsaxatilis 118
    vetustus 118
Myurella simplex 57, 198

NACELLA *depicta* 317
    incessa 318
    instabilis 318
Nacella *paleacea* 319
Narona cooperi 217
Nassa 79, 230
    californiana 15, 19, 24, 28, 31, 32, 43, 55, 62, 79, 231, 232
    corritensis 25, 28, 31, 32, 43, 62, 79, 231
    cooperi 17, 232, 234
    fossata 15, 19, 22, 24, 25, 28, 31, 32, 33, 43, 55, 56, 62, 79, 231, 232
    gibbesii 233
    insculpta 28, 43, 79, 233
    interstriata 234
    mendica 15, 17, 19, 22, 24, 25, 28, 31, 32, 43. 52, 55, 57, 62, 80, 233, 234
        var. cooperi 15, 19, 22, 24, 25, 28, 31, 32, 33, 43, 56, 62, 80, 232, 234
    mutabilis 230
    perpinguis 15, 17, 19, 22, 24, 25, 28, 31, 32, 43, 55, 56, 62, 80, 232, 234
    pedroana 239
    tegula 19, 22, 24, 25, 28, 31, 32, 43, 62, 80, 235, 236
    versicolor 236
        var. **hooveri** 28, 43, 80, 233, 236
    vibex 235
    woodwardi 233
Nassidæ 79, 230
Natica 83, 313
    algida 315
    ampullaria 315
    caurena 313
    clausa 15, 17, 19, 43, 52, 57, 65, 68, 313, 314
    (Cryptonatica) clausa 313
    duplicata 314
    lewisii 24, 25, 28, 31, 315
    (*Lunatia*) *lewisii* 43, 315
    mammilla 314
    recluziana 314
    reiniana 315
    russa 313, 314
Naticidæ 83, 313
Neæra 76, 181
    ornatissima 181
    pectinata 18, 37, 76, 181
Neptunea tabulata 228
Neverita 83, 314
    recluziana 15, 19, 22, 24, 25, 28, 31, 32, 43, 55, 56, 62, 83, 314, 315, 316
        var. alta 55
Nodipecten 72, 108
    subnodosus 72, 108
Norrisia 84, 331
    norrisii 24, 43, 62, 84, 323, 331
Nucula 72, 95, 96
    cœlata 98
    castrensis 15, 17, 18, 21
    (Acila) castrensis 37, 95
    conradi 95
    decisa 95
    divaricata 95

Nucula obliqua 96
suprastriata 18, 21, 27, 31, 36, 62, 72, 96
(Nucula) suprastriata 96
tenuis 96
Nuculacea 72, 95
Nuculidæ 72, 95
Nuttallia 76, 168
nuttalli 76, 168

Obeliscus *variegata* 280
Ocinebra 80, 254
barbarensis 19, 22, 43, 52, 80, 254, 259
erinaceus 254
foveolata 28, 43, 80, 255
interfossa 15, 19, 22, 24, 25, 28, 43, 62, 80, 255, 259
keepi 24, 43, 80, 256
lurida 25, 43, 62, 80, 256, 257
var. aspera 19, 22, 24, 25, 28, 31, 43, 52, 55, 80, 257
var. cancellina 28, 43, 80, 257
var. **cerritensis** 19, 22, 25, 31, 43, 80, 258
var. munda 19, 43, 80, 258
micheli 25, 43, 80, 259
perita 19, 24, 25, 28, 43, 52, 62, 80, 254, 255, 259
poulsoni 19, 22, 24, 25, 28, 31, 43, 62, 80, 260
Odostomia 82, 281
(*Evalea*) *æquisculpta* 284
(Oscilla) æquisculpta 284
(Chrysallida) **diegensis** 284
(Evalea) elegans 281
gouldii 19, 22, 43, 52, 55
(Evalea) gouldii 282
(Oscilla) **grammatospira** 285
insculpta 281
interstincta 281
(Evalea) lirata 284
nuciformis 283
var. avellana 19, 43, 52, 55, 62, 283
(Amaura) nuciformis var. avellana 283
plicata 281
(Amaura) pupiformis 283
sandvicensis 281
satura var. *pupiformis* 283
(Evalea) **stearnsii** 282
tenuis 22, 23, 28, 43, 55, 62, 82, 281
var. gouldii 282
(Ivara) terricula 285
unidentata 281
Œdalia subdiaphana 153
Œdalina subdiaphana 153
Olivella 79, 219
biplicata 15, 17, 19, 22, 24, 25, 28, 31, 32, 33, 43, 52, 55, 56, 62, 79, 219, 220, 221
bætica 57, 221
intorta 15, 19, 22, 24, 25, 28, 31, 32, 33, 44, 55, 56, 62, 79, 220, 221
pedroana 15, 19, 22, 24, 25, 28, 31, 32, 44, 55, 57, 63, 79, 220, 221
undatella 219
Olividæ 79, 219
Omphalius 84, 327
fuvescens 327
ligulatus 327
pfeifferi 326
viridulum var. ligulatum 84, 327, 339
Ondina 281
sulcata 281
Opalia 81, 266
anomala 58, 63, 81, 266
borealis 28, 44, 81, 266
coronata 266
crenatoides var. insculpta 44, 81, 267
varicostata 58, 63, 81, 267
Opisthobranchiata 77, 188
Opsichitonia 85, 313
Oscilla 82, 284
æquisculpta 82, 284
grammatospira 82, 285
Ostracea 72, 102
Ostrea 57, 72, 102
conchaphila 49
edulis 102
lurida 18, 21, 25, 27, 31, 32, 37, 49, 56, 63, 72, 102
var. expansa 102
var. rufoides 102
maxima 103
veatchi 63
Ostreidæ 72, 102
Oudardia buttoni 157

Pachydesma *crassatelloides* 143
Pachypoma 84, 321
cœlata 321
gibberosum 321
inæquale 22, 23, 25, 28, 44, 84, 321
Paludestrina 83, 305
curta 22, 23, 28, 44, 83, 305
piscium 305
stokesi 22, 23, 28, 44, 83, 305
Pandora 73, 123
(Kennerlia) bicarinata 123
bilirata 123
(Kennerlia) filosa 124
punctata 124
Pandoridæ 73, 123
Panomya 77, 183
ampla 15, 37, 65, 77, 183
Panopea 76, 182
estrellana 182
generosa 15, 18, 23, 27, 31, 37, 52, 68, 76, 178, 182, 183
var. globosa 182
var. solida 182
norvegica 183
(Mya) norvegica 183
Paracyathus 71, 88
caltha 88
humilis 88

Paracyathus pedroensis 46, 71, 88, 89, 90
    stearnsi 88, 89
Parapholas penita 184
Patella aculeata 308
    antiquatus 312
    insessa 318
    instabilis 318
Patelloida depicta 317
Patinopecten 72, 107
    caurinus 72, 107
    expansus 72, 108
Pecten 72, 103, 107, 108, 115, 116
    æquisulcatus 33, 56, 114
    bellus 51, 52, 53, 72, 104, 106
    (Pecten) bellus 103
    caurinus 14, 15, 17, 18, 25, 52, 58, 65, 68, 107, 108
    (Patinopecten) caurinus 37, 107
    circularis 114
    dentatus 27, 67, 101, 105
    (Pecten) dentatus 37, 72, 104
    denticulata 27, 31
    diegensis 104, 105, 106
    expansus 58, 63, 107, 108
    (Patinopecten) expansus 108
    floridus 106
    (Hinnites) giganteus 115
    hastatus 15, 18, 25, 52, 63, 109, 110, 111, 115
    (Chlamys) hastatus 37, 109
    hemphilli 51, 58, 63, 72, 104, 105
    (Pecten) hemphilli 103, 105
    hericeus 15, 18, 63, 65, 68, 109, 110, 111
    (Chlamys) hericeus 37, 110
        var. strategus 18, 37, 110
    inca 114
    intermedius 108
    islandicus 107, 109
    jordani 15, 17, 18, 52
    (Chlamys) **jordani** 37, 111
    laqueatus 105
    latiauritus 18, 21, 23, 25, 27, 31, 32, 33, 37, 63, 111, 112
        var. **fragilis** 27, 31, 37
        var. monotimeris 18, 21, 23, 25, 27, 31, 32, 33, 37, 55, 63
    (Chlamys) latiauritus 111
        var. **fragilis** 112
        var. fucicolus 112
        var. monotimeris 112
    maximus 103
    mesotimeris 111
    monotimeris 112
    newsomi 27, 31, 113
    (Plagioctenium) **newsomi** 37, 113
    nodosus 108
    opuntia 52, 53, 63, 111
    (Chlamys) opuntia 113
    propatulus 107
    stearnsii 15, 37, 58, 63, 104, 105, 106
    (Pecten) stearnsii 72, 106
    subnodosus 23, 27, 108
Pecten (Nodipecten) subnodosus 37, 108
    subventricosus 63, 113
    (Plagioctenium) subventricosus 114
    tumidus 114
    tunica 111
    ventricosus 23, 25, 27, 31, 32, 33, 55, 56, 63, 113, 111
    (Plagioctenium) ventricosus 37, 114
    yessoensis 67, 107
Pectinacea 72, 103
Pectinidæ 72, 103
Pectunculinæ 72, 100
Pectunculus corbis 110
    patulus 131
    septentrionalis 101
        var. *subobsoleta* 101
Pelecypoda 15, 17, 18, 21, 23, 25, 27, 30, 33, 35, 72, 95
Penitella 77, 184
    penita 77, 184
    spelæa 184
Periploma 73, 121
    alta 122
    argentaria 23, 25, 27, 31, 37, 63, 73, 121, 122
    excurva 122
    inæquivalvis 121
    lenticularis 122
    planiuscula 122
Periplomidæ 73, 121
Petricola 75, 154
    arcuata 154
    californica 154
    carditoides 18, 23, 25, 27, 31, 33, 37, 56, 63, 75, 154, 155, 156
    cognata 75, 156
    (Petricolaria) cognata 37, 156
    cordieri 155
    cylindracea 154
    denticulata 18, 27, 31, 37, 75, 155, 156
    (Petricolaria) denticulata 155
    gibba 154
    (Rupellaria) lamellifera 155
    lapicida 154
    lithophaga 155
    pedroana 155
    pholadiformis 155, 156
Petricolaria 75, 155
    cognata 156
    denticulata 155
Petricolidæ 154
Petrophila 78, 197
Phasianella 84, 321
    compta 19, 22, 28, 44, 63, 84, 321
    fulmoides 321
Phasianellidæ 321
Pholadidæ 156, 183
Pholadidea 77, 184
    loscombiana 184
    penita 15, 23, 25, 27, 31, 37, 48, 50, 184
    (Penitella) penita 184
Pholadinæ 77, 183

Pholas concamerata 184
  conradi 184
  crispata 183
  penita 184
Phoreus 84, 328
  magus 328
  pulligo 25, 44, 84, 328
Phyllonotus paucivaricata 246
Physa 78, 196
  fontinalis 196
  heterostropha 22, 23, 44, 78, 196
Physidæ 78, 196
Pisania 79, 227
  fortis 24, 28, 44, 56, 63, 79, 227
  pusio 227
Pisces 28, 47, 85, 346
Placunanomia alope 116
  cepio 116
  macroschisma 56, 116
  (*Monia*) *machroschisma* 116
Plagioctenium 72, 113
  newsomi 72, 113
  subventricosus 72, 114
  ventricosus 72, 114
Planorbinæ 77, 195
Planorbis 77, 195
  corneus 195
  tumidus 22, 23, 28, 44, 77, 195
  vermicularis 22, 23, 28, 44, 77, 195
Platyodon 76, 179
  cancellatus 23, 25, 27, 31, 37, 76, 179
Pleurotoma 77, 199, 228
  aurantia 206
  babylonia 199
  bartschi 15, 19
  (Borsonia) **bartschi** 44, 200
  carinata 216
  carpenteriana 24, 25, 28, 32, 55, 56, 63, 203
  (Dolichotoma) carpenteriana 44, 202
  (*Surcula*) *carpenteriana* 202
  cooperi 28
  (Dolichotoma) **cooperi** 44, 203
  dalli 15, 19
  (Borsonia) **dalli** 44, 201
  gibbosa 204
  hooveri 19
  (Borsonia) **hooveri** 44, 201
  inermis 205
  linearis 210
  mitræformis 202
  montereyensis 206
  (*Drillia*) *montereyensis* 207
  pedroana 19
  (Leucosyrinx) **pedroana** 44, 202
  penicillata 205
  perversa 15, 19, 22, 24, 28, 31, 44, 56, 77, 200, 216
  ponderosa 211
  pudica 208
  pyrenaica 200
Pleurotoma **renaudi** 15, 19
  (Drillia) **renaudi** 44
  smithi 15, 19
  (Spirotropsis) **smithi** 44, 216
  stromboides 211
  tryoniana 28
  (Dolichotoma) tryoniana 44, 203
  (*Surcula*) *tryoniana* 203
  turricula 209
Pleurotomidæ 77, 199, 210
Pododesmus 73, 116
  macroschisma 23, 25, 27, 52, 63, 68, 116, 118
  (Monia) macroschisma 37, 116
  rudis 116
Polynices 83, 314
  (Lunatia) lewisii 315
  (Neverita) recluziana 314
   var. alta 315
Polyplacophora 85, 342
Polyplex gracilis 250
Pomaulax 84, 322
  undosus 25, 28, 44, 56, 63, 84, 322
Poromyacea 73, 126
Potamis sacratum 296
Priene 82, 286
  cancellatus 286
  oregonensis 15, 19, 24, 25, 28, 44, 68, 82, 286
Prionodesmacea 72, 95
Protocardia 74, 142
  centifilosa 15, 17, 18, 37, 52, 74, 142
Psammobia 76, 167, 168
  edentula 27, 37, 76, 168
  (Psammobia) edentula 168
  feroënsis 167
Psammobiidæ 76, 167
Psephis 75, 152
  lordi 152
  salmonea 18, 21, 37, 52, 75, 152
  tantilla 18, 21, 23, 27, 31, 37, 75, 152, 153
Pseudoliva kellettii 230
Ptenoglossa 81, 262
Pteronotus 80, 244
  festivus 32, 63, 80, 244
  textilis 244
Pteropsidinæ 76, 177
Pterorhytis 80, 244
  foliatus 80, 245
  monoceros 80, 246
  nuttalli 80, 245
Ptychstylis caffea 327
Pulmonata 77, 194
Puncturella 85, 341
  cucullata 15, 19, 28, 44, 52, 85, 341
  galeata 15, 19, 44, 85, 341
  noachina 341
Purpura 50, 81, 260
  canaliculata 50
  crispata 24, 25, 28, 44, 48, 63, 68, 80, 227, 261
  (*Monoceros*) *lapilloides* 247
  lapillus 261

Purpura persica 260
saxicola 28, 44, 55, 80, 247, 261
Purpurinæ 81, 260
Pyramidella 82, 280
conica var. variegata 28, 44, 82, 280
plicata 280
Pyramidellidæ 81, 269
Pyrgisculus 81, 277
laminata 81, 277
Pyrgiscus 81, 274
auricoma 81, 274
crebrifilata 81, 276
latifundia 81, 275
subcuspidata 81, 277
tenuicula 81, 275, 276
Pyrgolampros 81, 278
adleri 81, 280
arnoldi 82, 279
gibbosa 81, 279
lowei 81, 278
var. **pedroana** 81, 279
mioperplicatulus 278
Pyrgostelis 274
Pyrgostylus 272

Ræta 76, 177
undulata 18, 37, 57, 76, 174, 177
Ranella 82, 287
californica 24, 25, 28, 31, 44, 63, 82, 287
muriciformis 248
plicata 248
spinosa 287
triquetra 248
Rexithærus secta var. *edulis* 164
Rictaxis 77, 188
punctocælata 77, 188, 189
Rimula cucullata 341
galeata 341
Ringicardium 74, 139
procerum 74, 139
Rissoa 83, 304
acutelirata 28, 44, 55, 83, 305
costulata 304
Rissoidæ 83, 304
Rowellia 197
radiata 197
Rupellaria 75, 155
lamellifera 23, 37, 75, 155
Sanguinolaria 76, 168
californica 161
nuttalli 27, 31, 37, 68, 168
(Nuttallia) nuttalli 168
sordida 161
Saxicavidæ 76, 182
Saxicava carditoides 154
Saxidomus 75, 151
aratus 18, 23, 25, 27, 31, 33, 37, 48, 55, 63, 75, 151
gracilis 151
nuttallii 151
Scala 81, 262
bellastriata 28, 44, 81, 263, 264
(*Opalia*) *borealis* 266
crebricostata 22, 23, 24, 28, 44, 55, 63, 81, 263, 265
hemphilli 28, 44, 81, 263, 264
hindsii 19, 22, 24, 28, 31, 45, 81, 263, 264, 265
indianorum 15, 19, 22, 24, 25, 28, 31, 45, 81, 263, 264
pretiosa 262
tincta 19, 22, 24, 25, 28, 31, 32, 45, 55, 63, 81, 263, 264, 265
Scalaria bellastriata 263
borealis 266
crebricostata 263
hindsii 264
indianorum 265
var. *tincta* 265
subcoronata 264
tincta 265
Scalidæ 81, 262
Scaphandridæ 77, 192
Scaphopoda 19, 22, 24, 25, 28, 31, 47, 77, 185
Schizopyga californiana 231
californica 231
Schizothærus nuttalli 178
scopali 75
ponderosa 75
Scrobicularia biangulata 160
Scurria mitra 318
Scutella 71, 91
excentrica 91
(Echinarachnius) excentricus 91
interlineata 16
striatula 91
Scutellidæ 71, 91
Seila 82, 290
assimilata 19, 45, 82, 290
Selachii 85, 346
Semele 76, 165
decisa 21, 23, 27, 31, 38, 63, 76, 165, 166
pulchra 27, 31, 38, 63, 76, 166
var. **montereyi** 18, 38, 76, 166
Semelidæ 75, 165
Septifer 73, 119
bifurcatus 18, 38, 119
heberti 119
lampe 73
Serpulorbis 83, 299
arenaria 299
squamigerus 19, 22, 24, 25, 28, 31, 32, 45, 63, 83, 299
(Vermicularia) 299
Sigaretus 84, 316
debilis 31, 45, 84, 316, 317
neritoideus 316
Siliqua 76, 172
californica 173
lucida 18, 21, 27, 31, 38, 63, 76, 172, 173
nuttalli 173

Siliqua patula 76, 173
    var. nuttalli 27, 38, 63, 172, 173
  radiata 172
Silsquaria edentula 168
Siphonalia 79, 229
  kellettii 25, 28, 31, 45, 63, 68, 79, 229
  nodosa 229
Siphonium (Dendropoma) lituella 299
Solariella 84, 334
  cidaris 15, 45, 67, 334
  oxybasis 334
  peramabilis 15, 45, 67, 85, 334, 335
Solecurtus californianus 169
  lucida 172
  nuttalli 173
  radiata 172
Solen 76, 171
  gibbus 169
  marginatus 171
  radius 172
  rosaceus 18, 21, 23, 25, 27, 38, 63, 76, 171
  sicarius 15, 17, 18, 21, 23, 25, 27, 31, 38, 76, 171, 172
    var. *rosaceus* 171
Solenacea 76, 171
Solenidæ 76, 171, 172
Solenoconchia 77, 185
Sphairella tumida 134
Sphænia californica 180
Spiroglyphus 83, 299
  lituella 24, 25, 28, 31, 45, 83, 299
  spirorbis 299
Spirotropsis 79, 216
  smithi 79, 216
Spisula 76, 175
  catilliformis 76, 176
  falcata 76, 174, 176
Standella californica 174
  falcata 176
  nasuta 176
Stereosomata 71, 90
Strephona pedroana 221
Streptodonta 81, 262
Streptoneura 78, 198
Strioturbonilla 81, 270
  alpina 270
  muricata 81, 270
  similis 81, 270
  stearnsii 81, 271
  torquata 81, 271
    var. stylina 81, 272
Strongylocentrotus 71, 90
  franciscanus 20, 46, 71, 90
  purpuratus 20, 46, 53, 63, 71, 90
Styliferina 82, 295
  tenuisculpta 19, 45, 82, 296
Stylommatophora 77, 194
Surcula carpenteriana 202
  perversa 200
  tryoniana 203
Tænioglossa 82, 285
Tagelus 76, 169
  californianus 23, 25, 27, 31, 32, 38, 49, 65, 75, 76, 169, 173
Tapes 75, 149, 151
  diversum 150
  gracilis 151
  laciniata 27, 31, 38, 150
  lineatum 150
  litterata 149
  montana 145
  staminea 18, 21, 23, 25, 27, 28, 31, 32, 33, 38, 48, 56, 63, 68, 75, 150
    var. *ruderata* 149
  tenerrima 23, 25, 27, 28, 31, 38, 55, 64, 75, 151
Tapetinæ 75, 149
Taranis 79, 215
  morchii 215
  strongi 15, 19, 22, 31, 45, 79, 215
Teleodesmacea 73, 127
Tellina 75, 156
  alta 160
  bodegensis 18, 21, 23, 25, 27, 31, 32, 33, 38, 64, 68, 158, 159, 165
  (Angulus) bodegensis 158
    buttoni 157
  (*Oudardia*) *buttoni* 157
  calcarea 161
  donacina 156
  emacerata 158
  idæ 31, 38, 158, 159
  (Angulus) idæ 158
  inquinata 162
  lanceolata 157
  lata 161
  ligamentina 164
  meyeri 160
  (*Angulus*) *modestus* var. *obtusus* 157
  nasuta 163
  obtusa 157
  pedroana 157, 161
  proxima 161
  reticulata 165
  rubescens 27, 38, 159
  (Angulus) rubescens 159
  (Mœrella) salmonea 157
  secta 164
  sordida 161
  striata 158
  subulosa 161
  tenera 161
Tellinacea 75, 156
Tellinella 158
Tellinidæ 75, 156
Terebra 57, 78, 198
  nebulosa 198
  simplex 15, 17, 19, 22, 24, 25, 28, 31, 32, 64, 198
  (Acus) simplex 45, 198
  variegata 198
Terebratalia 71, 92

- Terebratalia hemphilli 51, 52, 53, 71, 92, 93
  - obsoleta 92
  - **smithi** 15, 46, 71, 92, 93
- Terebratulidæ 71, 92
- Terebridæ 78, 198
- Thalotia 84, 327
  - caffea 15, 19, 45, 84, 327
  - conicus 327
- Thoracica 85, 344
- Thracia 73, 122
  - curta 122
  - pubescens 122
  - trapezoides 15, 17, 38, 73, 122, 123
- Thraciidæ 73, 122
- Thyasira 74, 135
  - bisecta 15, 17, 38, 65, 74, 135, 136
  - (Cryptodon) bisecta 14
  - flexuosus 135
  - gouldi 15, 17, 38, 74, 135, 136
- *Thyatira bisecta* 135
- Tivela 74, 142
  - crassatelloides 18, 23, 25, 27, 31, 32, 33, 38, 64, 74, 143, 153
- Tornatella 57
  - fasciata 188
  - *punctocælata* 188, 189
- Tornatina 77, 189
  - cerealis 19, 22, 28, 45, 64, 77, 189
  - coarctata 189
  - culcitella 19, 22, 24, 25, 28, 31, 45, 52, 55, 64, 77, 190
  - eximia 15, 45, 77, 190
  - harpa 45, 55, 64, 77, 191
- Tornatinidæ 77, 189
- *Toxocidaris franciscana* 90
- Toxoglossa 78, 198
- Trachycardium 74, 138
  - quadrigenarium 74, 139
- Tresus 76, 178
  - *maximus* 178
  - nuttalli 23, 25, 27, 31, 38, 64, 68, 76, 178, 180
- Triforidæ 82, 290
- Triforis 82, 290
  - adversa 19, 45, 82, 290
  - perversus 290
- *Trigonella crassatelloides* 143
- *Trigonia crassatelloides* 143
  - *stultorum* 143
  - *tantilla* 153
- Triton 287
  - *gibbosus* 28, 286
  - *oregonense* 286
  - (*Priene*) *oregonensis* 286
- Tritonidæ 82, 285
- Tritonium 82, 285
  - gibbosus 45, 82, 286
  - *luridum* 256
  - *oregonense* 286
  - oregonensis 68
  - (Priene) oregonensis 286
  - variegatus 285
- Trivia 82, 288
  - californica 28, 45, 82, 288, 289
  - quadripunctata 288
  - solandri 45, 82, 289
- Trochidæ 84, 324
- *Trochischus convexus* 331
  - *norrisii* 331
- *Trochus annulatus* 329
  - *aureotinctus* 324
  - *brunneus* 321
  - *canaliculatus* 329
  - *costatus* 330
  - *funebralis* 325
  - *gallina* 326
  - (*Monodonta*) *gallina* 326
  - *gibberosus* 321
  - *inæqualis* 321
  - *ligulatus* 327
  - *luridus* 327
  - *montereyi* 326
  - *pulligo* 328
  - *pupillus* 333
  - *undosus* 322
- Trophon 65, 80, 249
  - **cerritensis** 19, 31, 250
  - (Boreotrophon) **cerritensis** 45, 249
  - clathratus 249
  - craticulatus 250
  - disparilis 251, 253
  - gracilis 15, 19, 52, 251
  - (Boreotrophon) gracilis 45, 250
  - multicostatus 19, 28, 250, 251, 252
  - (Boreotrophon) multicostatus 45, 251
  - orpheus 68, 252, 253
    - var. **præcursor** 15, 19, 45, 52, 253
  - pedroana 19, 22, 250, 252
  - (Boreotrophon) **pedroana** 45, 251
  - scalariformis 15, 19, 25, 56, 251, 252
  - (Boreotrophon) scalariformis 45, 252
  - stuarti 15, 17, 19, 45, 68, 250, 252, 256
  - (Boreotrophon) stuarti 252
  - tenuisculptus 15, 253
  - (Boreotrophon) tenuisculptus 45, 253
  - triangulatus 19, 254
  - (Boreotrophon) triangulatus 45, 254
- *Truncaria corrugata* 241
- Trygonidæ 85, 346
- Turbinidæ 84, 321
- Turbinolidæ 71, 86
- Turbonilla 55, 64, 81, 269, 281
  - **adleri** 19, 45
  - (Pyrgolampros) **adleri** 280
  - **arnoldi** 19, 45
  - (Pyrgolampros) **arnoldi** 279
  - *aspera* 291
  - aurantia 19, 22, 28, 31, 45
  - (Lancea) aurantia 272
  - (Pyrgiscus) **auricoma** 274
  - crebrifilata 19, 22, 31, 45
  - (Pyrgiscus) crebrifilata 276
  - (Lancea) elongata 272

Turbonilla gibbosa 19, 46
(Pyrgolampros) gibbosa 279
laminata 19, 22, 28, 31, 46, 55
(Pyrgisculus) laminata 277
latifundia 46
(Pyrgiscus) **latifundia** 275
lowei 19, 22, 28, 31, 46, 279
(Pyrgolampros) **lowei** 278
var. **pedroana** 279
mexicana 280
muricata 19, 22, 46
(Strioturbonilla) muricata 270
pentalopha 19, 46
(Lancea) **pentalopha** 274
plicatula 269
plicatulus 269
similis 19, 22, 31, 46
(Strioturbonilla) similis 270
stearnsii 22, 23, 28, 31, 46, 270, 271
(Strioturbonilla) **stearnsii** 271
subcuspidata 19, 22, 28, 31, 46
(Pyrgiscus) subcuspidata 277
tenuicula 19, 22, 28, 31, 46, 276
(Pyrgiscus) tenuicula 275, 276
torquata 19, 46, 272
var. stylina 19, 22, 46, 271
(Strioturbonilla) torquata 271
var. stylina 272
tridentata 19, 22, 31, 46, 52, 273
(Lancea) tridentata 273
typica 269
Turcica (Ptychstylis) caffea 327
Turcicula cidaris 334
Turritella 83, 300
apicalis 300
cooperi 15, 17, 19, 22, 24, 25, 28, 31, 32, 46, 54, 55, 56, 57, 64, 83, 300, 301
jewettii 15, 19, 24, 25, 28, 46, 83, 300, 301
sanguinea 300, 301
terebra 300
Turritellidæ 83, 300

UROLOPHUS 85, 346
halleri 28, 47, 85, 346
Urosalpinx cancellinus 257

VENERACEA 74, 142
Venericardia 74, 128
barbarensis 15, 17, 18, 25, 27, 32, 38, 52, 74, 128
borealis 57
var. *ventricosa* 128
planicostata 128
ventricosa 15, 17, 18, 38, 52, 56, 57, 64, 128
Veneridæ 74, 142, 147
Venerinæ 74, 142
Venerupis cordieri 155
Venus 75, 146
bisecta 135
brevilineata 149
californica 149
callosa 145
Venus *cortezi* 147
fluctifraga 27, 147
(Chione) fluctifraga 38, 147
gibbosula 147
gnidia 27, 67, 147
(Chione) gnidia 38, 147
kennerleyi 146
lamellifera 149, 150, 155
lapicida 154
maxima 151
neglecta 27, 31, 148
(Chione) neglecta 38, 148
nuttalli 149
perlaminosa 51, 52, 75, 146
rigida 150, 151
rysonia 153
securis 149
simillima 15, 18, 23, 25, 27, 31, 148
(Chione) simillima 38, 148
staminea 150
succincta 23, 25, 27, 31, 149
(Chione) succincta 38, 149
tantillus 153
verrucosa 146
Vermetidæ 83, 299
Vermetus squamigerus 299
Vermicularia 19, 46, 83, 299
Vertebrata 85, 346
Verticordia 73, 126
cardiiformis 126
novemcostata 18, 38, 73, 126
ornata 126
Verticordiidæ 73, 126
Vitrinella 64, 85, 335
anomala 335
williamsoni 19, 28, 46, 85, 335
Vitularia aspera 257
Vola 57
dentata 104
Volvaria alba 192
Volvarina 79, 222
varia 19, 22, 24, 25, 28, 31, 46, 64, 79, 222
Volvula 77, 191
acuminator 191
cylindrica 19, 46, 64, 77, 191

YOLDIA 72, 99
amygdala 100
arctica 99
cooperi 27, 38, 55, 64, 72, 99, 100
impressa 99
myalis 99
scissurata 18, 38, 72, 99, 100

ZIRPHÆA 77, 183
crispata 56, 184
gabbii 23, 25, 27, 31, 32, 38, 56, 77, 184
Zizyphinus annulatus 329
canaliculatus 329
filosus 330
Zygobranchia 85, 336

(Continued from Second Page of Cover.)

17. Phycological Memoirs. By De Alton Saunders. pp. 22. 21 *plates*.

18. The Phosphorescent Organs in the Toadfish Porichthys notatus Girard. By Charles Wilson Greene. pp. 24. 3 *plates*.

19. New Mallophaga, III. Comprising Mallophaga from Birds of Panama, Baja California and Alaska. By Vernon L. Kellogg. **Mallophaga from Birds of California.** By Vernon L. Kellogg and Bertha L. Chapman. **The Anatomy of the Mallophaga.** By Robert E. Snodgrass. pp. 229. 17 *plates*.

20. The Nature of the Association of Alga and Fungus in Lichens. By George James Peirce. pp. 36. 1 *plate*.

21. Studies on the Flower and Embryo of Sparganium. By Douglas Houghton Campbell. pp. 38. 3 *plates*.

22. The Development and Phylogeny of Placenticeras. By James Perrin Smith. pp. 60. 5 *plates*.

23. Studies on the Coast Redwood, Sequoia sempervirens Endl. By George James Peirce. pp. 24. 1 *plate*.

24. Description of Two New Genera of Fishes (Ereunias and Draciscus) from Japan. By David Starr Jordan and John Otterbein Snyder. **Description of Three New Species of Fishes from Japan.** By David Starr Jordan and Edwin Chapin Starks. pp. 10. 4 *plates*.

25. Notes on Coccidæ (Scale Insects): Notes on Cerococcus. By Rose W. Patterson. **New and Little Known California Coccidæ.** By S. I. Kuwana. **The Redwood Mealy Bug** *(Dactylopius sequoiæ sp. nov.)*. By George A. Coleman. **The San Jose Scale in Japan.** By S. I. Kuwana. pp. 50. 6 *plates*.

26. Studies on Ciliate Infusoria. By N. M. Stevens. pp. 44. 6 *plates*.

27. Coccidæ (Scale Insects) of Japan. By Shinkai Inokichi Kuwana. pp. 56. 7 *plates*.

28. The Anatomy of Epidella squamula, sp. nov. By Harold Heath. pp. 30. 2 *plates*.

29. The Root-tubercles of Bur Clover (Medicago denticulata Willd.) and of Some Other Leguminous Plants. By George James Peirce. pp. 34. 1 *plate*.

30. The Net-Winged Midges (Blepharoceridæ) of North America. By Vernon L. Kellogg. pp. 50. 5 *plates*.

31. The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California. By Ralph Arnold. pp. 420. 37 *plates*.

Address,

CHARLES H. GILBERT,

Stanford University, California.

CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
OF THE
LELAND STANFORD JR. UNIVERSITY

XXXII

THE FISHES OF PANAMA BAY

By CHARLES H. GILBERT AND EDWIN C. STARKS

[Reprinted from the Memoirs of the California Academy of Sciences
Vol. IV]

STANFORD UNIVERSITY, CALIFORNIA
1904

Contributions from the Hopkins Laboratory.

1. **The Fishes of Sinaloa.** By David Starr Jordan. pp. 142. 29 *plates.*

2. **On the Cranial Characters of the Genus Sebastodes.** By Frank Cramer. pp. 42. 14 *plates.*

3. **The Fishes of Puget Sound.** By David S. Jordan and Edwin C. Starks. pp. 71. 29 *plates.*

4. **New Mallophaga, I,** with special reference to a Collection made from Maritime Birds of the Bay of Monterey, California. By Vernon L. Kellogg. pp. 144. 15 *plates.*

5. **Notes on Fishes, Little Known or New to Science.** By David Starr Jordan. pp. 48. 24 *plates.*

6. **Notes on Fresh Water Fishes of the Pacific Slope of North America.** By Cloudsley Rutter. **Description of a New Species of Pipe-Fish (Siphostoma sinaloæ) from Mazatlan.** By David S. Jordan and Edwin C. Starks. **Notes on Deltistes, a New Genus of Catostomoid Fishes.** By Alvin Seale. pp. 29.

7. **New Mallophaga, II,** from Land Birds, together with an account of the Mallophagous Mouth-Parts. By Vernon L. Kellogg. pp. 118. 14 *plates.*

8. **List of Fishes Collected at Port Ludlow, Wash.** By Edwin Chapin Starks. pp. 14. 2 *plates.*

9. **Marine Fossils from the Coal Measures of Arkansas.** By James Perrin Smith. pp. 72. 9 *plates.*

10. **Scientific Names of Greek and Latin Derivation.** By Walter Miller. pp. 31.

11. **A Morphological Study of Naias and Zannichellia.** By Douglas Houghton Campbell. pp. 68. 5 *plates.*

12. **Geology of the Paleozoic Area of Arkansas South of the Novaculite Region.** By George H. Ashley. 31 *cuts.* 2 *maps.*

13. **The Development of Glyphioceras and the Phylogeny of the Glyphioceratidæ.** By James Perrin Smith. pp. 28. 3 *plates.*

14. **A Geological Reconnaissance of the Coal Fields of the Indian Territory.** By Noah Fields Drake. pp. 93.

15. **Description of a Species of Fish (Mitsukurina owstoni) from Japan, the Type of a Distinct Family of Lamnoid Sharks.** By David Starr Jordan. pp. 5. 2 *plates.*

16. **The Development of Lytoceras and Phylloceras.** By James Perrin Smith. pp. 32. 5 *plates.*

(Continued on Third Page of Cover.)

CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
OF THE
LELAND STANFORD JR. UNIVERSITY

XXXII

THE FISHES OF PANAMA BAY

By CHARLES H. GILBERT AND EDWIN C. STARKS

[Reprinted from the Memoirs of the California Academy of Sciences
Vol. IV]

STANFORD UNIVERSITY, CALIFORNIA
1904

PREFATORY NOTE.

This memoir is the thirty-second of a series designed to illustrate investigations and explorations connected with the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. These investigations have been carried on by means of the assistance given by Timothy Hopkins, Esq., of Menlo Park, California. This memoir appears in the publications of the California Academy of Sciences, the present edition being a reprint.

OLIVER P. JENKINS,
CHARLES H. GILBERT,
Directors Hopkins Laboratory.

Date of publication, February 6th, 1904.

THE FISHES OF PANAMA BAY.

BY

CHARLES H. GILBERT AND EDWIN C. STARKS.

CONTENTS.

PLATES I–XXXIII.

INTRODUCTION 3
LIST OF NEW SPECIES 5
SYSTEMATIC ACCOUNT OF SPECIES 5
GENERAL REMARKS ON DISTRIBUTION 205
TABLE OF DISTRIBUTION 206
BIBLIOGRAPHY 219
EXPLANATION OF PLATES 228
INDEX 293

INTRODUCTION.

THE ichthyologic history of Panama Bay falls naturally into three periods. The first, beginning with 1860, depended upon the activity of Captain John M. Dow, whose collections, forwarded to the Smithsonian Institution and to the British Museum, were reported upon by Dr. Theodore Gill and Dr. Albert Günther. This early work culminated in 1869 through the publication of Günther's "Fishes of Central America," which contains an admirable summary of the state of our knowledge at that date, with valuable discussions of the faunal relations of both marine and fresh-water forms.

The second period was characterized by the work of Dr. Franz Steindachner, based in part upon his own collections, in part upon material obtained through various correspondents. No general summary was given by him, but the diagnoses of new species, which appeared in his series of "Notizen" and "Beiträge" (See Bibliography), form a model of accurate and detailed work of that description.

The third period has resulted from investigations undertaken either directly or with the assistance of the United States Fish Commission and the Smithsonian Institution. Under their auspices Dr. Gilbert made in 1881 large collections of the fishes of Panama, which served as the basis for numerous papers by Jordan and Gilbert. A second and much larger collection, made by him in 1883, was unfortunately destroyed by fire, together with all field-notes and the manuscript report then ready for the printer. The only record of this material is embodied in a list published by Jordan (1885). The new species indicated in that list remained, for the most part, still undescribed and unrepresented in any museum at a period ten years later!

The deeper waters off the Panama Bay, out as far as the Galapagos Islands, were thoroughly explored by the United States Fish Commission steamer Albatross in 1888 and 1891. Reports upon the fishes thus obtained have been given by Jordan and Bollman (1889), by Gilbert (1890 *b*), and recently in most admirable and complete form by Garman (1899).

The following account of the fishes of Panama Bay is based primarily upon material obtained in 1896 by an expedition from the Leland Stanford Junior University, generously equipped and sent out by Mr. Timothy Hopkins of Menlo Park, California. The party consisted of Dr. C. H. Gilbert and Messrs. E. C. Starks, C. J. Pierson and R. C. McGregor. During the six weeks (January 10th to February 24th) spent in residence at Panama, an almost hourly inspection of the excellent fish-market was maintained; the tide-pools of the reef were explored, and the rocks and islands near the city were investigated by the aid of dynamite. The effectiveness of the party became so reduced by illness during the last weeks of their stay, that they were unable to carry out that part of their plans which contemplated the exploration of the Pearl Islands on the one hand and the rivers of the Isthmus on the other. These localities offer still a rich field for investigation. Of the two hundred and eighty-three marine species obtained, forty-three were new, and included among them all but four (*Tylosurus* sp., *Cynoscion* sp., *Scarus* sp., and *Citharichthys* sp.) of the still undescribed forms of the list of 1885. Descriptions of many of the new species have already appeared in the different volumes of Jordan and Evermann's "Fishes of North and Middle America," and full accounts of all appear in the present paper.

We have admitted to our list all previous records of fishes from Panama Bay, unless good reason exists for doubting their validity. Several general references to "Panama," in Jordan and Evermann's work above cited, seem not to be based upon special records, and are rejected by us, even where there is a general probability of their occurrence at Panama in view of the known range of the species. Of the fishes obtained by the Albatross, we have included such only as were dredged within the fifty-fathom line. Even when thus restricted, the assemblage is found to contain many forms which are rarely or never taken along shore, and seem to constitute a sublittoral fauna of characteristic shallow-water species. The genera *Prionotus*, *Symphurus* and *Diplectrum* offer numerous examples of such species.

List of New Species.

Types of all new species are deposited in the Ichthyological Collections of the Leland Stanford Junior University, and bear the numbers indicated in the following list:—

Carcharias velox	11893
Carcharias cerdale	11884
Carcharias azureus	11890
Myliobatis asperrimus	11895
Galeichthys xenauchen	5821
Galeichthys eigenmanni	6986
Tachysurus emmelane	5818
Tachysurus evermanni	6706
Tachysurus steindachneri	7026
Pisoodonophis daspilotus	5820
Muræna clepsydra	6807
Anchovia rastralis	5812
Anchovia mundeola	5817
Anchovia naso	5816
Anchovia starksi	5814
Cetengraulis engymen	5815
Hemiramphus saltator	6806
Fistularia corneta	6808
Oligoplites refulgens	6799
Hemicaranx zelotes	5819
Peprilus snyderi	6800
Lobotes pacificus	5883
Lutianus jordani	11988
Rhegma thaumasium	5978
Sagenichthys mordax	6809
Larimus effulgens	5520
Odontoscion xanthops	5519
Stellifer illecebrosus	5515
Stellifer zestocarus	5518
Ophioscion simulus	5516
Polyclemus goodei	5517
Eques viola	5521
Pomacentrus gilli	6803
Halichæres macgregori	6801
Xesurus hopkinsi	12671
Balistes verres	6805
Prionotus ruscarius	6488
Microgobius miraflorensis	6511
Evermannia panamensis	6509
Batrachoides boulengeri	6487
Porichthys greenei	6485
Hypsoblennius piersoni	6522
Homesthes caulopus	5623

Family GINGLYMOSTOMIDÆ.

1. **Ginglymostoma cirratum** *(Gmelin).*

A single specimen taken, 27 cm. long. The body and fins are light brownish, marked with small black spots about as large as pupil, those in front of dorsal arranged rather uniformly in cross-series. Snout unspotted. Lower side of head whitish, unspotted.

Family GALEIDÆ.

2. **Mustelus lunulatus** *(Jordan & Gilbert).*

Plate I, Fig. 1.

Five specimens were secured seeming to agree in all respects with an individual collected by Dr. Jordan from the type locality, Mazatlan. In a young male 53 cm. long the claspers do not project beyond the edge of the ventral fin; in another 64 cm. long they are fully developed, protruding beyond edge of ventral for about 4 cm. A male from Mazatlan (68 cm. long) has the claspers undeveloped, not reaching beyond margin of ventrals. This seems to indicate considerable irregularity in the sexual development of the species. The young of *M. lunulatus* are as yet unknown.

The Panama specimens agree well with the original description of the species, except in the following respects:

(*a*) Distance from insertion of first dorsal to anterior root of pectoral ⅖ (not "about ½") its distance from tip of snout. This discrepancy is due, however, to an error in the original description. Mr. Barton A. Bean has kindly re-examined the type, and states that the first distance is contained about 2⅖ times in the second.

(*b*) Distance between dorsals 2⅓ to 2½ times (not "2⅗ times") base of first, and 2⅔ to 3¼ times ("a little more than 3 times") base of second. Mr. Bean gives base of first dorsal 2⅗ and base of second dorsal 3½, in the interspace between dorsals. This interval is therefore longer in the type than in any of the Panama specimens. The latter agree, however, with the Mazatlan specimens above mentioned.

A specimen of *M. lunulatus* in the United States National Museum (No. 46838), taken by the "Albatross" at the mouth of the Mulegé River, Gulf of California, has the proportions of the type. The base of the first dorsal, excluding the fleshy hump which precedes the rays, is contained 2⅗ times in the interval between dorsals, the base of the second dorsal 3½ times in this interval. It is evident, therefore, that the size and relative positions of the dorsal fins must be used with caution for specific distinction.

(*c*) Middle of dorsal base usually midway between axil of pectorals and anterior insertion of ventrals, sometimes very slightly nearer pectorals. In none of the Panama specimens is it nearer the base of the pectorals by a distance equaling the diameter of the eye, as given in the description of the type (slightly less than this in the type according to Mr. Bean).

Following are dimensions of a Panama specimen:—

	mm.
Total length	530
Length of head	95
Length of snout	43
Diameter of orbit	17
Length of spiracle	3.5
Length of middle gill-slit	14
Distance from tip of snout to front of mouth	34.5
Distance from tip of snout to inner angle of nostrils	27
Distance between nostrils	14
Distance between angles of mouth	28
Distance from tip of mandible to line joining posterior angles of lips	21
Extreme length of upper lip	5.5
Extreme length of lower lip	8
Distance from tip of snout to base of pectorals	113
Greatest width of pectoral base	23
Outer pectoral margin	71
Inner pectoral margin	40
Distal pectoral margin	57
Axil of pectoral to base of ventrals	107
Snout to base of ventrals	230
Outer edge of ventrals	40

	mm
Base of ventrals	27
Snout to base of dorsal fin proper, not including fleshy ridge	107
Base of first dorsal	51
Height of anterior margin of first dorsal (not including fleshy hump at base)	65
Height of posterior margin	29
Distance between dorsals	125
Base of second dorsal	39
Distance from second dorsal to base of upper caudal lobe	52
Length of upper caudal lobe	110
Distance from tip of caudal to base of notch	41
Distance from base of notch to origin of lower lobe	75
Distance from origin of lower caudal lobe to base of anal	39
Base of anal	26

A specimen of *Galeus californicus* from Magdalena Bay, Lower California (No. 1404 L. S. J. U.) compared with *M. lunulatus* has the fins less incised and with rounded angles, the snout broader and less pointed, the lips longer, about equaling width of nostril, and the dorsal more backward in position, its base contained three and one-fourth in its distance from snout. The angle of the mouth is also much greater.

G. californicus ranges to the southward along the entire coast of Lower California and throughout the Gulf of California, where it is found associated with *M. lunulatus.* It occurs doubtless at Mazatlan, although it has not yet been recorded from that point. It was obtained by the "Albatross" in 1889 at San Quentin and Magdalena bays on the outer coast of Lower California, and in Concepcion Bay, San Luis Gonzales Bay, and at Station 3026 in the Gulf of California. The foetuses reported from Guaymas by Evermann and Jenkins (1891, p. 129), under the name of *Galeus dorsalis*, belonged to *G. californicus*, as is sufficiently evident from their measurements.

3. Galeus dorsalis *Gill.*

PLATE I, FIG. 2.

Previous diagnoses have called attention to the low, comparatively little-incised fins, and the short caudal. More conspicuous differences are found in the small size of the eye, the large spiracle, and the large nostrils. The diameter of the eye is contained 2⅔ to 3 times in the distance from tip of snout to front of upper jaw. In *M. lunulatus* of the same size, it is contained twice in this distance. The width of the internasal septum is less than the distance from inner angle of nostrils to margin of snout, while greater than this distance in *M. lunulatus.* The spiracle is a long slit, ⅖ or more than ⅖ diameter of eye. The nasal valve is smaller than in related species, produced mesially into a narrow flap, the width of which does not exceed ⅓ width of nostril. The inner folds are also much simpler and smaller, and fail to conceal the olfactory membrane. The snout is narrower and sharper, with the outlines less curved; it is also thinner, so as to appear whitish-translucent. The pores on snout are much more conspicuous than in related species, and contribute to give it a spongy texture; they are numerous on top and sides of snout as well as below, and are clustered to form a conspicuous patch below front of eye. The shagreen is much coarser than in *M. lunulatus.*

Both pectorals and ventrals have broad, rounded outer angles, and have the posterior margins straight or nearly straight when the fin is spread. The pectoral contrasts strongly with that of *M. lunulatus*, where the outer angle is prolonged, giving the fin a falcate shape. The tip of the pectoral reaches to or slightly beyond the vertical from the middle of the dorsal base. The first dorsal is low, with rounded anterior angle and gently concave margin, the anterior angle failing to reach the tip of the posterior angle when the fin is declined. Both dorsals are longer in proportion than they are in *M. lunulatus*, and the caudal peduncle as well as the caudal fin shorter. The base of the second dorsal equals in length the back of caudal peduncle; the base of the anal equals in length the lower side of the caudal peduncle. The bases of second dorsal and anal are much shorter than caudal peduncle in *M. lunulatus*. The angle of the lower caudal lobe is rounded or slightly angulated, never acute, the outline very gently concave next the angle. The margin of the posterior lobe is broad, evenly truncate when spread.

Following are measurements of a specimen from Panama:—

	mm.
Total length	468
Length of head (to first gill-slit)	84
Length of head (to last gill-slit)	107
Length of snout	41
Diameter of orbit	10.5
Length of spiracle	4
Tip of snout to front of mouth	31
Tip of snout to inner angle of nostrils	27
Distance between nostrils	11
Distance between angles of mouth	25
Distance from tip of mandible to line joining posterior angles of lips	18
Extreme length of upper lip	7
Extreme length of lower lip	6
Tip of snout to base of pectoral	107
Width of pectoral base	24
Outer pectoral margin	68
Inner pectoral margin	39
Distal pectoral margin	47
Axil of pectorals to base of ventrals	105
Snout to base of ventrals	233
Outer edge of ventrals	36
Base of ventrals	27
Snout to base of first dorsal	152
Base of first dorsal	52
Height of anterior margin of first dorsal	53
Height of posterior margin of first dorsal	17
Distance between dorsals	100
Base of second dorsal	41
Back of caudal peduncle	41
Length of upper caudal lobe	85
Tip of caudal to base of notch	30
Base of notch to origin of lower lobe	62
Origin of lower lobe to base of anal	29
Base of anal	28

This species is known as yet only from the Bay of Panama. Like *G. californicus*, from which it differs widely in other respects, it has the young attached to the oviduct by a placenta. The three specimens obtained by this expedition are all females; one of them contains well developed young.

4. Galeocerdo tigrinus *Muller & Henle.*

Recorded from Panama by Jordan and Bollman (1889, p. 179), their specimen having been collected by the "Albatross." The species was not seen by the authors.

5. Carcharias æthalorus *Jordan & Gilbert.*

Abundant at Panama, where it is used as food though not highly prized. Small specimens only were seen. In a male about 90 cm. long, the claspers are very small, not reaching margin of ventrals. The teeth of both jaws are distinctly serrate in these young examples, the serræ growing coarser towards base, equally present on the two margins. The interspace between dorsals is 5 to 6 times base of second dorsal (excluding the fleshy ridge before fin), and the base of anal considerably less than ($1\frac{2}{5}$ in) its distance from caudal. In other respects the Panama specimens answer well the original description.

6. Carcharias velox *(Gilbert).*

PLATE I, FIG. 3.

Carcharinus velox, GILBERT, JORDAN & EVERMANN, 1898, p. 2747.

Distinguishable from other known sharks of the Pacific coast of America by the excessively long, slender, acute snout, the slender body, and the very long caudal fin.

Preoral portion of snout slightly more than $1\frac{2}{3}$ times width of mouth, 5 times distance between nostrils, $1\frac{2}{3}$ times width of snout opposite outer angles of nostrils, $1\frac{1}{4}$ times interorbital width, $2\frac{1}{6}$ times distance from chin to line joining angles of mouth. Nostrils transverse in position, the inner angle nearer mouth than tip of snout by a distance slightly less than length of nostril. Front of eye equidistant from nostril and front of mouth, the middle of eye nearer angle of mouth than nostril; diameter of eye less than nostril, slightly more than half longest gill-slit. Snout very porous. Folds at angle of mouth slightly longer than usual. Gill-slits rather wide, the middle slit $1\frac{3}{4}$ times diameter of orbit.

Teeth of lower jaw very narrow, erect, very minutely serrulate, appearing entire except with the lens. The species thus represents a transition between *Carcharias* and the alleged genus *Hypoprion*. Teeth in upper jaw very oblique, wide at base, with a deep notch on outer margin, the terminal cusp rather narrowly triangular.

Pectoral broadly falcate, the anterior margin convex, the distal edge concave, both angles rounded. Tip of pectoral reaching a short distance beyond base of first dorsal. Anterior margin of pectoral $2\frac{3}{5}$ times the posterior (inner) margin, about $1\frac{1}{8}$ times the distal edge. First dorsal inserted about the diameter of orbit behind a vertical from axil of pectoral; nearer pectoral, therefore, than ventral. The anterior margin is concave basally, convex on distal half, the anterior angle rounded. The free margin is concave, largely owing to the much produced acute posterior lobe. The vertical height exceeds the length of the base; the anterior lobe very high, extending beyond tip of posterior when the fin is declined, equaling $\frac{3}{5}$ length of anterior margin of pectoral. Posterior margin of first dorsal $3\frac{1}{4}$ in the anterior margin. Base of first dorsal contained $2\frac{1}{2}$ times in interspace between dorsals, base of second dorsal $6\frac{2}{7}$ times. Margin of second dorsal gently concave. Front margin low, the angle broadly rounded, barely reaching posterior end of base when fin is declined. The posterior lobe is much produced and acute, slightly longer than base of fin, the latter $1\frac{6}{7}$ in the distance from its base to front of caudal pit. Upper lobe of caudal $3\frac{2}{3}$ in total length; the lower lobe $2\frac{1}{2}$ in the upper. Terminal lobe of caudal $3\frac{2}{3}$ in the upper lobe. Anal larger than second dorsal, higher, with deeply incurved margin, its base a little longer, its origin slightly in advance of that of second dorsal; the posterior insertions of the two fins nearly opposite. Length of anal base $1\frac{3}{5}$ in its distance from anterior edge of caudal pit.

Color bluish above, whitish or grayish below. Free margin of pectorals narrowly white, the anterior edge narrowly bordered with black, which is most evident when seen from the outer surface, the inner surface being dusky. The first dorsal is unmarked, the second dorsal has the anterior lobe dusky. Upper edge of caudal black, the lower margin faintly dusky. Fins otherwise unmarked.

A single specimen, a female, 120 cm. long, was procured in the Panama market. As preserved, it is partially skinned. The following measurements were taken when the specimen was intact, before preservation. Where not exactly agreeing with dimensions given above, the latter will be found more reliable.

	mm.
Tip of snout to insertion of dorsal	413
Base of first dorsal	111
Distance between dorsals	280
Base of second dorsal	45
From second dorsal to front of caudal pit	73
Front of caudal pit to tip of caudal	350
Tip of snout to axil of pectorals	380
Axil of pectorals to front of base of ventrals	283
Front of ventrals to front of anal	165
Front of anal to front of caudal pit	116
Girth at front of first dorsal	451

7. **Carcharias cerdale** *(Gilbert.)*

PLATE II, FIG. 4.

Carcharinus cerdale GILBERT, JORDAN & EVERMANN, 1898, p. 2746.

Body moderately compressed, not elevated, the depth at front of dorsal not more than one-fourth greater than the oblique anterior margin of the dorsal fin, less than the distance from the nostril to the first gill-slit. Head depressed, the snout flattened, long and narrow, acute. Length of snout beyond mouth $\frac{1}{6}$ to $\frac{1}{10}$ greater than distance between angles of mouth in all but one (the largest) specimen, where it is slightly less than width of mouth; $\frac{3}{5}$ to $\frac{4}{5}$ greater than distance from tip of lower jaw to a line connecting angles of mouth; $\frac{1}{7}$ to $\frac{1}{12}$ greater than width of snout opposite outer angle of nostrils. Interorbital width equaling distance from tip of snout to front of eye in the young, to middle or posterior border of eye in older specimens; less than half distance to first gill-opening. Middle of eye nearer nostril than angle of mouth by $\frac{1}{2}$ to $\frac{4}{5}$ its diameter. Distance from eye to nostril $\frac{1}{2}$ or slightly more than $\frac{1}{2}$ distance from nostril to tip of snout. Middle of nostrils much nearer front of mouth than tip of snout. Nasal flap with a very narrow, short, acute lobe, placed at end of inner third of flap. Outer angle of nostrils nearly at margin of snout, the inner angles separated by a distance equaling or slightly exceeding that between inner angle of nostril and back of eye. Lips very little developed, the lower entirely concealed in closed mouth, the upper visible as a very short fold.

Teeth in lower jaw narrow, erect, serrulate on both margins, more coarsely so toward base. The serration is more conspicuous in the smallest specimens (45 cm.), and is obsolescent on some of the teeth in adults. Teeth in upper jaw broadly triangular, in front of jaw narrower and erect, those in sides of jaw growing at once broader and more oblique. The lateral teeth have a strong notch on the outer side. Both margins are strongly serrate, the serrations increasing toward base, one or more of those below notch sometimes enlarged and cusp like in adults. Teeth about $\frac{32}{28}$.

Conspicuous areas of large and of small pores on under side of head. Gill-openings of moderate width, the longest equaling distance between eye and nostril, the fifth much shortened, about $\frac{3}{4}$ length of first. Eye small, equaling length of nasal opening, $1\frac{3}{4}$ to 2 in middle gill slit.

Pectoral short and broad, the posterior margin not strongly incurved. Tip of fin extending to a vertical intersecting dorsal base at origin of its posterior third or fourth. Anterior margin of pectoral 3 times length of inner or posterior margin, the latter less than width of base. First dorsal beginning behind a vertical from axil of pectorals a distance about equaling that which separates eye from nostril. Free margin of fin gently concave, the anterior angle extending to a point midway between base and tip of posterior lobe, when the fin is depressed. Base of first dorsal $2\frac{1}{2}$ to $2\frac{2}{3}$ in interspace between dorsals. Base of second dorsal 7 in interspace between dorsals, $2\frac{1}{3}$ in its distance from anterior margin of pit. The origin of second dorsal falls over or behind middle of anal base. The fin is but slightly concave, with rounded anterior angle; its posterior angle much produced; the posterior margin exceeding base of fin, which about equals length of anterior margin. Anal inserted more anteriorly than second dorsal, its base longer, its margin much more deeply concave, the length of base contained about $1\frac{1}{3}$ times in its distance from lower caudal lobe. Lower caudal pit in advance of the upper. The caudal is broad throughout, the lower lobe not falcate, slightly less ($\frac{1}{10}$ to $\frac{1}{4}$) than half length of upper lobe, which is about $4\frac{1}{4}$ in total length. Shagreen coarse.

Color varying from light to dark gray above, the belly and lower part of sides whitish. Fins all dusky or grayish, the caudal often with a blackish border. Pectorals with or without a black tip, the latter when present not as conspicuous as in *C. æthalorus*, usually not extended onto inner face of fin. A specimen 73 cm. long has the claspers undeveloped, extending slightly beyond margin of ventrals. Another specimen, 85 cm. long, has the claspers fully developed, extending beyond the margin of the ventrals for a distance of 5 cm.

Abundant at Panama, where numerous specimens were secured.

C. cerdale strongly resembles *C. æthalorus*, with which it is associated in the Bay of Panama. It is distinguishable at sight by the narrower gill-slits, broader and less falcate fins, and by the much less conspicuous black tips to the pectorals. The dentition is very dissimilar in the two, and makes it necessary to arrange them in different parts of the genus, *C. cerdale* belonging to the subgenus *Platypodon*.

8. **Carcharias azureus** sp. nov.

Cazon Azul.

Plate II, Fig. 5.

Snout very short and bluntly rounded, its outline nearly parallel with cleft of mouth, the length of its preoral portion $1\frac{2}{3}$ to $1\frac{1}{5}$ in distance between angles of mouth, constantly greater than distance from chin to line joining angles of mouth, and very slightly ($\frac{1}{7}$ to $\frac{1}{10}$) less than distance between inner angles of nostrils. Width of snout opposite nostrils equals distance from angle of mouth to first gill-slit. Eye nearer mouth than nostril, nearer nostril than angle of mouth. Outer angle of nostril midway between tip of snout and middle of eye. Eye small, its horizontal diameter $\frac{3}{4}$ nostril opening. Nostrils converging along lines which meet a short distance behind symphysis. The anterior margin is produced into a short, triangular flap. Width of mouth equaling half length of head in front of gill-slits. Gill-slits wide, equaling or slightly exceeding the distance from eye to nostril, about equaling length of branchial area. Two very short diverging furrows visible at angle of mouth, one representing as usual the obsolescent upper lip.

Teeth in upper jaw broadly triangular, oblique, the anterior edge gently convex, the inner gently concave and often with a slight notch dividing the margin into equal parts. Teeth in lower jaw erect, narrowly lanceolate from a broad base. All the teeth are strongly serrate on both margins.

Pectorals long and wide, concave posteriorly, hence appearing falcate, their tips extending slightly beyond base of first dorsal. Both angles are broadly rounded. Upper margin of pectorals $3\frac{1}{3}$ to $3\frac{1}{2}$ times lower margin, and $1\frac{1}{3}$ to $1\frac{1}{4}$ times the posterior margin; its length equals that of head in advance of first gill-slit. A line joining axil of pectorals passes in front of origin of first dorsal a distance equaling diameter of orbit. Base of first dorsal contained $1\frac{2}{7}$ to $1\frac{1}{5}$ times in anterior margin of fin, and $1\frac{3}{4}$ or $1\frac{4}{5}$ times in the interspace between dorsals. Upper margin concave, the posterior but little produced, contained $3\frac{2}{3}$ to $3\frac{5}{6}$ times in anterior margin. Second dorsal inserted well in advance of anal, the length of its base contained $2\frac{1}{2}$ to $2\frac{2}{3}$ times in base of first dorsal, $4\frac{1}{2}$ to $4\frac{3}{4}$ times in the interspace, $1\frac{2}{5}$ to $1\frac{1}{2}$ times in its distance from front of caudal pit. Posterior lobe of second dorsal extends nearly half-way to origin of upper caudal lobe. Front of anal under end of first third of dorsal base, the two fins nearly equal in length, the anal perhaps slightly the longer. Margin of anal much more deeply concave. Distance from anal to origin of lower caudal lobe contained $1\frac{1}{3}$ times in distance from second dorsal to origin of upper caudal lobe. Caudal slightly exceeding $\frac{1}{4}$ the total length; the lower lobe with rounded angle appearing bluntly falcate, contained $2\frac{1}{4}$ times in upper lobe.

Color uniform light blue or bluish gray above, white below. Caudal and second dorsal black margined; the lower caudal lobe and distal half of pectoral largely blackish.

This species is well known though not abundant at Panama, and is more highly prized as food than other sharks. It appeared in the market on two occasions during the stay of the expedition, and three specimens were preserved, measuring from 92 to 95 cm. Two of these are males with the claspers quite undeveloped, not nearly reaching margin of ventrals. The species is said to reach a large size.

C. azureus is extremely near *C. nicaraguensis*, from Lake Nicaragua and its outlet, the San Juan River. Dr. Jordan has kindly compared the above description with a specimen of *C. nicaraguensis* (No. 39913) in the United States National Museum. The latter has a longer and wider snout, the length of which is contained $1\frac{1}{2}$ in its preoral portion, its width opposite the nostrils equaling the distance from the angle of the mouth to the third gill-slit. The base of the first dorsal is $\frac{1}{2}$ the interspace between dorsals, and the base of the second dorsal is contained $2\frac{1}{3}$ times in the first. The lower caudal lobe is contained $2\frac{2}{3}$ in the upper lobe. The pectoral is but faintly dusky. These differences are not great, but there has been no opportunity to make a direct comparison. In view of the exceptional distribution of *C. nicaraguensis*, known only from fresh waters, which belong to the Atlantic slope, it has not been thought wise to make the identification.

9. Scoliodon longurio *Jordan & Gilbert.*

Abundant at Panama, where six specimens were obtained. The length of the base of the first dorsal is contained $2\frac{3}{4}$ to nearly 3 times in the interspace between dorsals, not $2\frac{1}{4}$ times, as stated by Jordan & Evermann (1896, p. 42). The teeth are not at all serrate in the Panama specimens; the thin margin is sometimes gently sinuate, but never toothed.

Family SPHYRNIDÆ.

10. Sphyrna tiburo (*Linnæus*).

Reported for the first time from the Pacific Coast of America by the Hopkins Mazatlan Expedition (Jordan, 1895 *b*, p. 383), which secured a single specimen. Although overlooked by previous observers, the species seems to be not rare at Panama.

Three specimens were preserved, each about 50 cm. long. A number of larger specimens were seen, from one of which were obtained a number of fully developed embryos. These measure about 20 cm. in length, and exhibit perfectly the reniform shape of the head characteristic of this species. The groove forward from the nostrils is better developed in the embryos than in older individuals, being considerably more prominent even than in specimens of *S. tudes*, 60 cm. long. In examples of *S. tiburo*, 60 cm. long, the prenasal groove is but little less distinct than in *S. tudes* of the same size. In the Panama specimens of *S. tiburo* there is a more decided fold at the angle of the mouth. In *S. tiburo* the head is both longer anteroposteriorly and wider than in *S. tudes*, the greater length being in large part due to the greater convexity in the curve of the anterior profile. Thus in *S. tiburo* a line joining inner angle of nostrils cuts off the anterior $\frac{3}{5}$ of the snout; in *S. tudes*, the anterior $\frac{2}{5}$ only. The angle between anterior and lateral margins of head is more obtuse in *S. tiburo*, owing to this increased convexity of the anterior profile. The angle is as distinct, however, as in *S. tudes*, and the current statement concerning *S. tiburo*, "anterior and lateral margins of head confluent into a semicircle," is by no means justified.

11. Sphyrna tudes (*Cuvier*).

In common with other species of "Hammer-heads," *S. tudes* is frequently brought into the Panama market. It is undoubtedly abundant along the entire Pacific coast of Mexico and Central America. Several specimens were secured.

12. Sphyrna zygæna (*Linnæus*).

Still more abundant than the preceding species, appearing in the market almost daily. Several specimens were obtained.

Family SQUALIDÆ.

13. Squalus sucklii (*Girard*).

Jordan and Evermann (1896, p. 54) suggest that a single species of *Squalus* may be found to extend from the coast of California (*S. sucklii*) to Chile ("*S. fernandinus*"). In that case, it would be to this species we should assign the Panama record given by Günther (1868, p. 396).

March 2 1903.

Family PRISTIDÆ.

14. **Pristis zephyreus** (*Jordan & Starks*).

A saw, 80 cm. long, was procured fresh in the market. A young specimen entire, 90 cm. in total length, was taken in fresh or slightly brackish water in a tributary of the Rio Grande at Miraflores. The smaller specimen agrees well with the type of the species.

Some statements in the original description which might lead to confusion are explained or corrected below.

The teeth are all deeply grooved behind, the groove with sharply trenchant edges. In both of the Panama specimens the teeth are in 22 pairs. The interspaces between the hind teeth are 4 times the base of teeth in the young, 2½ times in the adult. The length of the front teeth is slightly more than ½ the breadth of the saw between them in young, 2⅔ in this width in adults. Distance between first and second tooth 2¼ times base of first in young, twice base of first in adult. Width of mouth slightly less than distance between tips of hinder teeth. The "slant height of pectoral" of the original description includes the anterior margin of the whole pectoral mass, from its angle forward to a point just behind eye. The "lower lobe" of caudal is the distance from anterior insertion of lobe to tip of fin. The saw in the type is 28 cm. long from base to tip, 31 cm. from tip of saw to front of nostril.

Family RHINOBATIDÆ.

15. **Rhinobatus leucorhynchus** (*Günther*).

Seen on two occasions only.

The relationship is extremely close between this species and *R. glaucostigma*, which is abundant at Mazatlan. *R. leucorhynchus* has no slate-colored spots on the back, and no black blotch on the under side of the snout. The rostral ridges are much narrower, and the rostral cartilage tapers more anteriorly. The snout is broadly triangular, with almost perfectly straight sides, which are slightly concave near tip, making the latter narrow and sharp. In *R. glaucostigma*, the rostral outline is slightly concave from its base to near the tip, where it becomes convex, thus making the terminal portion of the snout broader and more bluntly rounded. The posterior gill-slit is narrower, contained 1⅔ times in the fourth slit. In other details of structure, the two forms agree very closely, the proportions of disk and fins, the size of eyes, nostrils, and mouth, and the character of nasal flaps being wholly similar.

R. glaucostigma has been considered the northern representative of *R. leucorhynchus*, but is now recorded from the Bay of Santa Helena, near Guayaquil (Boulenger, 1898–9, Vol. XIII, p. 1). Its discovery at Panama is therefore to be expected.

16. **Zapteryx xyster** (*Jordan & Evermann*).

Known only from the type specimens, collected by Prof. F. H. Bradley at Panama, in 1866.

Family RAJIDÆ.

17. **Raja equatorialis** (*Jordan & Bollman*).

Known only from the type, which was dredged by the "Albatross" in 1888, at Station 2797, in the Bay of Panama, at a depth of thirty-three fathoms.

Family NARCOBATIDÆ.

18. **Narcine entemedor** (*Jordan & Starks*).

Not rare at Panama; five specimens seen in the market. Obtained also by Dr. Gilbert at Panama, in 1883.

The interorbital width is less than given in the original description. The least width of frontal cartilage between the eyes is contained three times in the preocular portion of snout; the distance between the eyes $1\frac{3}{4}$. The longitudinal diameter of the eyeballs, which somewhat protrude, equals or slightly exceeds the diameter of the spiracle. The spiracle is horseshoe-shaped, the eye entering its anterior border; everywhere except in front it is surrounded by a raised border which bears a single series of small tubercles. Series of pores are conspicuous on upper surface of snout, each pore often surrounded by a dark ring; a pair of much larger pores near middle line behind spiracles.

A deep fold of integument surrounds the lower jaw posteriorly, growing very low as it surrounds angle of mouth, and passing anteriorly to join the base of the frenum of the nasal valve. Laterally it is concealed by a still deeper fold, which overlaps it postero-laterally and is continuous anteriorly with the inferior nasal valve.

19. **Discopyge ommata** (*Jordan & Gilbert*).

Not seen by the expedition. First taken by Dr. Gilbert at Panama, in 1882. The type is from "Albatross" Station 2795, in the Bay of Panama, at a depth of thirty-three fathoms.

Family DASYATIDÆ.

20. **Urolophus halleri** (*Cooper*).

Not seen in 1896, but reported on previous occasions. *U. umbrifer* Jordan and Starks is one of the many color forms of this species. *U. nebulosus* has been ascribed to Panama (Jordan & Evermann, 1896, p. 81), but no authentic record of its occurrence can be found.

21. **Urolophus mundus** (*Gill*).

Urolophus asterias JORDAN & GILBERT, 1882 *m*, p. 579.

The types of *U. asterias*, obtained by Gilbert at Mazatlan and Panama in 1881, were originally identified as *U. mundus*, but were afterwards distinguished because of disagreement with the description of *U. mundus*, the types of the latter being lost. The discrepancies do not now seem very important, however, and it seems safe to identify *U. mundus* with the present species, which is abundant from Panama to the Gulf of California.

U. mundus was thought to be distinguished from other species, including *U. asterias*, by the short caudal spine, posteriorly inserted. If, however, the original description refers to the *posterior* point of insertion of the caudal spine, it agrees with *U. asterias*. Measured in that way, the insertion of the spine is usually behind the middle of the tail (measured from anus), and the length of the spine equals distance between snout and nostrils. *U. mundus* is said to have the skin "beset with numerous small stelliform tubercles, larger on the dorsal region," but no mention is made of the row of large spinous tubercles on median line of back and tail, characteristic of *U. asterias*. In *U. mundus* the distance of snout from hinder margin of pectorals is said to equal the width of the disk, while in *U. asterias* the disk is constantly somewhat wider ($\frac{1}{10}$ to $\frac{1}{15}$). If another species be discovered at Panama, with disk as wide as long, with stelliform prickles but with no median series of spines, the case will have to be reconsidered.

Five specimens were obtained by the expedition at Panama; three of them are males. The females are 42 and 31 cm. long, and contain embryos about two-thirds grown. The coloration in all the specimens is uniform dark brownish on upper side of disk, without the faint dusky spots found in a Mazatlan example. The fringe on velum is much less conspicuous in the Panama material. None of the specimens approach the closely related *U. rogersi* Jordan and Starks, which is undoubtedly distinct.

22. **Urolophus goodei** (*Jordan & Bollman*).

Not obtained by the expedition. The types were dredged by the "Albatross" at Station 2795, in Panama Bay, at a depth of thirty-three fathoms. Jordan and Evermann (1896, p. 81) state that this species was taken in Magdalena Bay, Lower California, but the present writers are unacquainted with the record. Boulenger (1898–9, Vol. XIII, p. 3) lists it from the Bay of Santa Helena, near Guayaquil.

23. **Urolophus aspidurus** (*Jordan & Gilbert*).

Abundant at Panama, where numerous specimens were secured, all but one of which are females. One contains embryos full grown.

The following corrections and additions may be made to current descriptions: The disk, taken to posterior margin of pectorals, is constantly a little broader than long; its length being less than that of tail measured from posterior insertion of ventrals. The amount of exsertion of the snout is very variable, the protruding portion being sometimes short and broad, sometimes long and narrow. The distance from eye to tip of snout is $3\frac{1}{3}$ or $3\frac{2}{5}$ in disk, measured as above. The posterior insertion of caudal spine is very slightly in advance of middle of tail (measured from anus). The bucklers on tail vary in the present specimens from one to seven (eight in one of the types); they have not appeared at birth, and are still undeveloped in a young specimen 15 cm. long. It will probably be found that there is always a regular series of seven or eight of these when they first appear, a variable number of them falling off later. In the adults, those remaining are usually unequally spaced, the interspaces often showing the scars of the lost bucklers. Minute asperities seem to be constantly present (at least in females), and are most numerous in a strip extending along the median line of disk. The teeth are much as in *U. mundus*, but are much more deeply grooved.

In females the teeth are flat without cusp, each tooth with a deep transverse groove, the hinder margin of which is elevated to form a ridge crossing the tooth transversely behind its middle. In the male, each tooth has a long acute median cusp; those in the upper jaw deeply grooved from base to tip along their anterior face, those in lower jaw transversely convex. In *U. mundus* the cusps of upper teeth in the males are provided with shallow grooves on basal portions only, and the transverse grooves on the flat teeth of the females are shallow, and followed by a lower transverse ridge. In embryos of *U. aspidurus*, the inner margin of spiracular rim is much elevated and produced anteriorly into a long slender coiled lobe, posteriorly into a much shorter projection. All trace of this raised rim disappears in the adult.

24. Dasyatis longa (*Garman*).

Not rare. One female specimen preserved.

Anterior margins of pectorals gently concave along the middle, becoming convex toward tip of snout, the latter abruptly projecting. The cutaneous fold on lower side of tail is low, not over 3 mm. in height; it begins opposite the anterior insertion of caudal spine, and is evident on about half the length of the tail. An extremely low ridge on back of tail behind caudal spine. The tail is very rough behind the caudal spine. A series of 34 coarse, spinous tubercles on median line of back, the three largest at intersection of median line with shoulder-girdle. Opposite this point are two short series of much smaller tubercles converging slightly backward. In addition to these, the interorbital region and the median area of back contain numerous stellate prickles, but few of which are behind the shoulder-girdle.

	mm.
Length of disk	355
Width of disk	420
Tail (from anal slit) evidently broken	790
Tip of snout to middle of nasal flap	80
Outer edge of ventrals	60
Anterior margin of pectorals	260
Longitudinal diameter of eyeball	20
Length of spiracle	25
Width of cartilage between eyes	38

Material is not at hand to decide the relation between *D. longa* and *D. dipterura*. The specimen listed by Jordan (1895 *b*, p. 389) from Mazatlan may be the latter, if the two species are distinct. In one of the Mazatlan specimens, with the disk 32 cm. long, the upper surface is naked, except three small spines on middle line near shoulder-girdle. The tail is also naked, and possesses, in addition to the very high cutaneous fold below, a free upper fin-fold half the height of the lower. It is probable that the two species are distinct.

25. **Pteroplatea crebripunctata** (*Peters*).

Three specimens seen at Panama.

The proportions of disk are not essentially different in *P. crebripunctata*, *P. rara*, and *P. maclura*. In all, the distance from tip of snout to front of anal slit equals half the width of the disk (or a little less than half in *P. rara*); and the extreme length of disk, from tip of snout to hinder margin of pectorals, is contained $1\frac{2}{3}$ to $1\frac{3}{4}$ times in the width. A line joining angles of disk intersects very slightly in advance of its middle a line from tip of snout to tip of tail.

P. crebripunctata and *P. maclura* are extremely close, differing principally in color, the marblings and spots being finer in *P. maclura*, and the lighter markings brighter in color, more sharply contrasting with the rest. *P. rara* has a sharper snout than the others, the rostral angle being, however, in excess of a right angle (110 degrees). The type of *P. raca* is a male specimen, 29 cm. long, with well developed claspers and no trace of caudal spine.

Family MYLIOBATIDÆ.

26. **Aetobatus narinari** (*Euphrasen*).

Frequently seen; three specimens preserved, one of which has measurements as given below.

Rostro-frontal fontanel narrowing anteriorly to opposite the hinder margin of eyes, then abruptly expanding; its greatest width anteriorly, 21 mm.; least width at the constriction, 13 mm ; greatest width posteriorly, opposite middle of spiracles, 18 mm.

	mm.
Tip of snout to front of anus	323
Tip of snout to posterior margin of pectorals	365
Width of disk	615
Length of tail (broken)	1200
Greatest breadth of head (at anterior origin of pectorals)	106
Width at eyes (including the latter)	87
Width of cranium opposite middle of eyes	53
Width of snout opposite front of eyes	56
Length of spiracle	31
Tip of snout to middle of nasal flap	61
Width of mouth	44
Diameter of iris	11

The Panama specimens agree entirely with those described by Jordan (1895 *b*, p. 391). The comparative measurements given in the paper cited are often erroneous, as will appear by comparing them with the above. The size of the spots is somewhat variable, and the length of the tail is unreliable, the latter being usually more or less shortened by injury.

27. Myliobatis asperrimus (*Gilbert*).

PLATE III, FIG. 6.

Myliobatis asperrimus GILBERT, (JORDAN & EVERMANN, 1898, p. 2754).

Upper surface of head and body, excepting the snout, an area on outer side of spiracle, the pectoral margin and its posterior angle, and the ventral fins, thickly covered with minute usually stellate prickles of uniform size, most numerous on median portions of head and back; those on basal half or two-thirds of pectorals are least crowded, and are arranged in definite longitudinal series, corresponding with the muscle bands. The tail is very rough throughout, being covered with similar stellate prickles. It is also crossed by numerous narrow grooves, or indented lines, mostly convex forwards, somewhat irregular in position and direction, and not corresponding on the two sides. In the type they follow at an average interval of about 10 mm. Lower side of disk mostly smooth, with some prickles on the basal part of pectorals anteriorly, arranged in lengthwise series, and other patches on lower side of head, belly and base of ventrals.

Rostro-frontal fontanel scarcely constricted anteriorly, the bounding ridges diverging abruptly at their anterior ends. Nasal flap with a shallow median notch, covering the mouth except the median portion of lower dental plate, its posterior margin coarsely fringed. Teeth in each jaw in one broad, median row, and three lateral rows; those of median row about five times as broad as long antero-posteriorly.

The color is dusky-brown above, the anterior portion of pectorals with eight or ten narrow, transverse bars of bluish-white, most of which break up into series of spots towards outer margin of disk, the posterior ones also breaking up towards middle line. The bars and spots are fainter anteriorly, becoming whiter and more intense posteriorly. Towards outer angles of disk the bars are sometimes separated by intermediate series of light round spots. The bars usually fail to meet across the back. The posterior portion of disk, including base of tail and upper surface of ventrals, is covered with round white spots not much larger than pupil; some of those immediately succeeding the bars show a transverse serial arrangement. The top of head shows one or more pairs of indistinct light spots. Margin of snout and of pectorals blackish. Spiracular border black. Dorsal with a black blotch posteriorly. Under side of head and disk bright white. Proximal portion of tail blackish above, lighter below, the entire tail becoming black posteriorly.

	mm.
Length of disk to front of anus	272
Length of disk to posterior edge of pectorals	338
Width of disk	345
Length of tail (not perfect)	1215
Greatest width of head, at origin of pectorals	79
Width of cranium, between orbits	45
Width of snout, opposite front of eye	55
Tip of snout to middle of nasal flap	60
Length of nasal flap	26
Greatest width of nasal flap	35
Diameter of iris	10½
Width of mouth	33
Distance between anterior gill-openings	75
Distance between posterior gill-openings	45
Distance from anterior to posterior gill-openings	45
Length of spiracle	26
Length of fontanel	60
Greatest width (at anterior end)	23

One specimen taken, a male, with undeveloped claspers which do not nearly reach the edge of ventrals.

Family SILURIDÆ.

28. **Felichthys panamensis** (*Gill*).

Abundant. Of the six specimens preserved, three are males and three females, all being of nearly equal size. The specimens do not differ according to sex in the shape of the dorsal buckler as extensively as is indicated in Steindachner's figures (1876 *b*, Plate II). Furthermore, such difference as exists is in the opposite direction to that observed by him, as the buckler is larger and proportionally somewhat wider in the females than in the males. More obvious sexual differences are found in the length of the ventral fins and in the shape of the anal. In females, the ventrals are long, constantly extending beyond the front of the anal. In males, they fail to reach the front of the anal fin. In females, the anterior portion of the anal fin is produced, forming a projecting lobe, thus giving a strongly concave arch to the posterior half of the margin of the fin. In males, there is no lobe, and the margin of the fin is nearly or wholly straight. This difference in the shape of the anal was noticed by Steindachner (1876 *b*, p. 15), but was supposed by him to be due to age and not to sex. Another sexual difference seems to exist in the size of the head, which in the present specimens is less in the case of the females, $3\frac{5}{7}$ to $3\frac{7}{8}$ ($3\frac{3}{5}$ in males). The specimens taken range from 325 to 360 mm. in length.

29. **Felichthys pinnimaculatus** (*Steinduchner*).

NEGRO ENCUERO.

One of the most abundant food-fishes of the Panama market. Sexual peculiarities seem much less strongly marked than in *F. panamensis*.

30. **Galeichthys lentiginosus** (*Eigenmann & Eigenmann*).

Frequently seen; nine specimens preserved.

The species is at once recognized by the very long narrow occipital process, by the depressed head, which is wide posteriorly and tapers rapidly forward to the narrow pointed snout, by the very convex mouth, and the usually smooth head. In the latter respect, however, there is much variation. The granulations may be confined to the occipital process and the posterior part of occiput, and be faintly visible where present, or they may entirely cover the crown forward to the interorbital space. In the latter case, the pattern of sculpture is exactly similar to that figured for *Netuma planiceps* (Steindachner, 1876 *b*, Plate IV), except that the granulations are less definitely in series, and that an evident groove extends backward from fontanel to near base of occipital process. The difference in roughness of the head is dependent neither on age nor sex. The specimen with best marked granulations is a female.

The narrow pointed snout, and large convexly curved mouth combine to give the latter a considerable lateral cleft, when seen from the side. The length of the head is very constant, $3\frac{3}{4}$ to $3\frac{9}{10}$ in length, when measured to margin of opercular membrane. Eye 3 to $3\frac{1}{2}$ in its distance from tip of snout. The upper jaw protrudes beyond the lower for about three-fourths the width of the thick upper lip. The maxillary barbels extend beyond base of pectoral spine, but not beyond its basal third. Pectoral pore variable, usually minute and detected with difficulty, occasionally an obvious slit.

The anal fin is very long, with perfectly straight margin, the rays declining regularly from the longest to the last. Five specimens have respectively 23, 24, 24, 24 and 25 anal rays, including rudiments. The anus is anteriorly placed, its distance from base of ventrals equaling half its distance from front of anal fin. All but one of the specimens are females, and have the inner edge of the ventrals and the upper side of the inner rays covered by a thickened fold of skin.

Light brownish in life, with blue and green reflections; the lower portion of the sides coarsely punctate with brown. The fins are all dusky toward tips, the basal portions dull orange yellow. Maxillary barbels blackish, the others white. The specimens answer well to the description of the types.

It is evident that the relative smoothness of the head cannot serve to distinguish the nominal genera *Galeichthys* and *Hexanematichthys*. The character is dependent partly on variation in the granulation of the bones, partly on the amount of thickening of the integument. Many species from different sections of the group show similar individual variations, according to which they might be placed in one or the other genus. The American species with villiform teeth and comparatively narrow crescentic palatine patches will be ranged under the oldest name, *Galeichthys*.

31. Galeichthys peruvianus (*Lütken*).

This rare species was not seen. Described originally from Callao, it has been recorded from Panama by Steindachner and by Gilbert, and from Altata, Mexico, by Steindachner. It has not been procured by any of the numerous investigators in northern Mexico.

32. Galeichthys eigenmanni, sp. nov.

PLATE IV, FIG. 7.

This species, found in abundance at Panama, and identified with *G. seemanni* by Eigenmann and others, seems to be an undescribed species. *G. seemanni* is from some unknown locality in Central America, not improbably from the Atlantic side. It is described (Günther, 1864 *a*, p. 147) as having the top of the head *finely* granular; the occipital process with a *prominent* ridge; vomerine patches of teeth *widely* separated; and particularly as having the *fontanel reaching to the base of the occipital process*. Dr. Jordan (1883, p. 282) has re-examined the type in the British Museum for this last character, and has found it as described. In all these respects the Panama specimens differ strongly, as shown below.

Head broad and flat, $3\frac{2}{3}$ to $3\frac{3}{4}$ in length; its depth at base of occipital process $1\frac{1}{2}$ to $1\frac{2}{3}$ in its length. The dorsal profile from dorsal spine to tip of snout nearly (appearing perfectly) straight. Snout wide and depressed, sharply wedge-shaped as viewed from the side; its length to a point on the median line of head between anterior margin of eyes $3\frac{3}{4}$ to 4 in head. The prefrontal does not form a protuberance in front of eye as in *G. jordani* and related species, the contour of snout rising uniformly to the edge of the dermal margin of eye. The interorbital area is flattened and wide; its width between dermal supraorbital margins 2 to $2\frac{1}{6}$ in head. The top of head is coarsely granular, the granulated area extending forward usually to above middle of orbit in two diverging areas, separated by a triangular continuation backward of the naked or smooth area of the snout. The length of the fontanel is variable in the present specimens, but in none of them does it reach the occipital process.[1] In two specimens evidently abnormal, the groove is very short, extending only to the apex of the triangular smooth area, which extends backward from interorbital space. Usually, however, the groove narrows backward uniformly, though sometimes constricted where it enters the granular area of the head, and extends to within $\frac{2}{3}$ diameter of eye of the occipital process. The occipital process is usually broader than long; in extreme cases it is broader than long by nearly the length of the basal plate of the dorsal spine; from this it varies to only as broad as long. The basal plate of the dorsal spine is twice, or a little more than twice, as broad as long. The median keel is lower than in *G. planiceps* or *G. jordani;* in some specimens it is scarcely evident at the termination of the fontanel, but grows stronger on the occipital process.

The maxillary barbel usually reaches base of pectoral spine; in one specimen to axillary pore, in several about to middle of opercle. The outer mental barbels often reach but $\frac{2}{3}$ distance to gill-openings, but sometimes extend beyond the latter. The vomerine patches of teeth usually meet on median line, or are separated by a narrow groove only. In but one specimen (an adult male) are they widely separated (as figured by Günther and Eigenmann). The eye is contained $6\frac{1}{2}$ to 7 times in the head, measured in a straight line from median tip of snout obliquely above eye to gill-opening.

As in other related species, the head is longer and the ventrals shorter in the male, the ventrals overlapping front of anal in females and provided with a very large fold of the integument. In the females the black of the ventrals passes gradually into the lighter margin. In males the transition between the two areas is abrupt. In five specimens examined, the gill-rakers are 5+10, 5+10, 6+10, 5+11, and 5+12. The pectoral pore is a long slit. The base of adipose fin is twice or nearly twice diameter of eye. The dorsal has 7 soft rays, and the anal 17 or 18. The length of the pectoral is very variable; measuring from base of spine to tip of soft rays, it is contained from $1\frac{1}{5}$ to $1\frac{1}{3}$ in head.

From *G. jordani* and other related species, *G. eigenmanni* can be at once recognized by the wider, flatter head, especially the more depressed snout, the smaller eye, the rougher head, and the less evident carina on the occipital process.

Three males and nine females were preserved.

It is not clear what species from Santa Helena Bay is referred to by Boulenger (1898–99, Vol. XIII, p. 5) under the name *Arius seemanni.* From his statement "Le *Galeichthys gilberti* Jord., n'en est pas séparable," we are disposed to believe that he had before him specimens of *G. jordani* rather than *G. eigenmanni.*

33. Galeichthys jordani (*Eigenmann & Eigenmann*).

Two specimens were obtained 250 and 345 mm. long. The larger individual is a female, with elongate ventrals overlapping the front of the anal fin, and provided on the upper surface of the inner rays with a much thickened fold of the integument, as in *G. platypogon* and *G. eigenmanni.*

---

[1] From a drawing kindly communicated by Professor Garman, it is learned that Eigenmann's material in the Museum of Comparative Zoology agrees with the present specimens in the length of the fontanel groove.

The specimens taken agree well with Eigenmann's description of the types, except in the size of the palatine patch of teeth, which is in adults about as large as in *G. eigenmanni*, and many times the size of the small vomerine patch. It is probably true of this species, as of *G. gilberti* from Mazatlan (Jordan and Gilbert, 1882 *b*, p. 47, under *Arius assimilis*), that the palatine bands vary "considerably in size and somewhat in form, the width ranging from ⅓ diameter of eye to ⅔, being generally larger in adults." Eigenmann's type of *G. jordani* was an immature specimen. In the smaller of our specimens the palatine patch is much less developed than in the adult, though somewhat larger and more ovate than in Eigenmann's figure.

In both of the specimens taken the fontanel groove terminates a very short distance in advance of the base of the occipital process, not reaching the base of process as described by Eigenmann.

The gill-rakers number 5+11 and 5+12, the most anterior being very minute. If the one at the branchial angle be reckoned with the vertical series instead of the horizontal, as above, one of the specimens will have the formula 6+10, as compared with Eigenmann's type 6+9.

Comparing the Panama material with the co-types of *G. gilberti* from Mazatlan, it is impossible to detect any appreciable differences, unless possibly in the color, which is lighter in the Mazatlan specimens. *G. gilberti* is said to lack the pectoral pore, but in reality possesses a minute round pore, as is evident in the co-types examined. The adult *G. jordani* from Panama has the pore likewise minute, while the younger example has a considerably larger, slightly elongate opening. The width of the mouth is the same in the Mazatlan and Panama specimens; measured externally, at the posterior labial angle, it equals the distance from the tip of the snout to the hinder margin of the pupil, and is contained 2¼ to 2⅓ times in the length of the head.

The two would be united without question, were it not that the co-types of *G. gilberti* (three in number) agree perfectly among themselves and differ from the Panama specimens of *G. jordani* in having the occipital plate much wider, more evenly rounded in transverse section, and with a much lower keel. The occipital plate is, in each of these specimens, wider than long by half the width of the basal plate of the dorsal spine. In *G. jordani* the width of the occipital plate is ⅘ or ⅚ its length. This plate is also much more sharply keeled and more densely granular. On the basis of these differences the two species are held provisionally distinct.

In both species the upper lobe of the caudal is longer and more falcate than in related species, reaching far beyond the lower lobe, and contained 3¼ to 3¾ in the length. The head is finely and often sparsely granular, the granular area not continued forward in any of the Panama specimens as far as a line joining posterior margins of orbits. The fontanel groove widens anteriorly, is rather deep, with sharply defined margins, and terminates abruptly, not "merging into the broad, flat, smooth, interorbital area" as is described in the type of *G. gilberti.*

34. **Galeichthys xenauchen** (*Gilbert*).

PLATE IV, Fig. 8.

Hexanematichthys xenauchen GILBERT (JORDAN & EVERMANN 1898, p. 2777).

In appearance, *G. xenauchen* is most closely allied to species of *Netuma*, having the low depressed head, with the lateral outlines converging forwards to the narrow pointed snout, and a long largely adherent adipose dorsal. The palatine patches are, however, narrow, and without backwardly projecting lobes. The species is distinguished from all those known from the Pacific Coast of America by the long and extraordinarily narrow occipital process.

Type, a female 38 cm. long.

Head $3\frac{3}{8}$ in length; depth at front of dorsal $5\frac{1}{2}$; anal with 23 rays. Width of head at opercle 1_{7} in its length; width at front of eyes 2 in head. Width of mouth at inner angles $2\frac{2}{5}$ in head. Interorbital width $2\frac{1}{10}$. Eye very small, 9 in head, $3\frac{1}{6}$ in its distance from tip to snout, $4\frac{5}{6}$ in postocular part of head, $4\frac{1}{3}$ in interorbital width.

Teeth all villiform. Mandibular bands well separated on middle line, very broad mesially, rapidly tapering to a point laterally, the band produced beyond angle of mouth, its greatest width contained $2\frac{1}{6}$ times in its length. Premaxillary band very convexly curved, following the outline of the snout, its width $5\frac{2}{3}$ in its length. Vomerine patches roundish, separated by an evident medial groove, marked off from the palatine patches by a narrower groove and a constriction. The palatine patches are equal in width to the vomerine patches, and less than twice as long. They are of nearly equal width throughout.

Maxillary barbels very slender, reaching slightly beyond the base of the pectoral spine. The mental barbels do not reach edge of gill-membrane, the outer pair equaling length of snout and half of eye. Nostrils very large, the anterior broadly oval, with widely reflexed rim, the posterior widely elliptical, not concealed by the valve. Distance from anterior nostril to tip of snout equaling that from posterior nostril to front of eye.

Fontanel wide, with nearly parallel edges on frontal region, abruptly narrowing at front of occiput, where it is continuous with a narrow and shallow groove. The latter fails to reach base of occipital process by a distance equaling half diameter of eye. The raised margins of the fontanel are continuous with a pair of sharp ridges bounding the groove, these accompanied by a pair of lower ridges on their outer sides and parallel with them. Posteriorly, these ridges are roughened with granules, and merge into the granulated area on posterior part of occiput. Occipital process granulated, the granules arranged in more or less definite lines radiating backwards and downwards on each side from median point of base. Lateral portions of occiput with an area of radiating striæ, separated from the central ridges by a smooth groove-like depression. A narrow granulated area extends forward on each side of fontanel to above back of orbits. The occipital process is very long and narrow, its width opposite its middle being but $\frac{2}{9}$ of its length. Near base it abruptly expands, the basal width being half its length plus that of dorsal plate on median line. Opercles and humeral plate weakly striate. Gill-membranes with a wide free fold posteriorly. Gill-rakers weak and short, 1 + 4 movable ones. No evident axial pore.

Dorsal spine slender, with a series of sharp granulations on anterior edge; minutely roughened, not serrate behind. It is broken in the type, but its length was about $\frac{2}{3}$ that of head. Pectoral spines rather slender, rough granular on outer margins, with short fine serræ within. Both are mutilated in the type, but their length was about equal to that of dorsal spine. The pectorals extend nearly $\frac{2}{3}$ distance to ventrals, the ventrals nearly to origin of anal. Distance from anus to base of ventrals $\frac{2}{3}$ its distance from front of anal. Anal fin very long, its base $1\frac{3}{4}$ in head, its longest ray $\frac{1}{3}$ head. Distance between dorsals $3\frac{1}{3}$ in length. Adipose fin long, highest about opposite the middle, with a short almost vertical free posterior margin. Its vertical height is $3\frac{5}{8}$ in its length, which is more than twice the distance from adipose fin to rudimentary caudal rays, greater than the base of the first dorsal, and equal to half the length of the head. Caudal fin with broad lobes, the lower rounded; the upper mutilated in the type, but evidently acute and longer than the lower.

Color purplish above, more bluish anteriorly; the lower parts silvery, coarsely punctate with brown. Fins all blackish, except the lower surface of the paired fins.

35. Galeichthys guatemalensis (*Gunther*).

This species was not seen by the authors. Recorded by Günther (1868, p. 393) from Panama; by Boulenger (1899, p. 2) from Rio Lara, Darien.

36. Galeichthys dasycephalus (*Günther*).

This species was occasionally seen; eleven specimens were preserved, all of which are females.

It answers well the description of Günther (1864 *a*, p. 157), and of Jordan and Gilbert[1] (1882 *b*, page 51), except that the head is constantly longer, 4 to $4\frac{1}{4}$ in length, and the dorsal spine is contained $1\frac{1}{2}$ instead of $1\frac{1}{4}$ times in head. The anal contains 21 rays, including the rudiments. The top of the head is constantly much rougher than in *G. longicephalus*, although exhibiting much variation in this respect. The fontanel groove reaches base of occipital process in all of the specimens taken.

37. Galeichthys longicephalus (*Eigenmann & Eigenmann*).

Taken occasionally; eight specimens were preserved, all of which are males.

There is little variation in the sculpturing of the head, which is either entirely smooth, invested with thick skin, or minutely roughened by a few scattered points. None of our specimens have the plates roughly granulated, as in *G. dasycephalus*.

The head is very constant in length, $3\frac{2}{5}$, $3\frac{2}{5}$, $3\frac{2}{5}$, $3\frac{2}{5}$, $3\frac{1}{2}$, $3\frac{2}{3}$, $3\frac{2}{3}$ and $3\frac{5}{6}$ times respectively in distance from tip of snout to base of caudal. The maxillary barbel reaches to base of pectoral spine, or to the end of its basal fourth. The outer mental barbels are variable, sometimes not reaching gill-opening, more often slightly beyond it. The eyes vary in length, and equal their distance from hinder end or middle of posterior nostril, and about half their distance from tip of snout. The width of mouth about equals the length of snout, $2\frac{5}{8}$ to $3\frac{1}{4}$ in head. In the description of the type, the width of mouth should doubtless stand $3\frac{1}{8}$, not $2\frac{1}{3}$, in head. The distance from the tip of snout to front of dorsal is contained $2\frac{2}{3}$ to $2\frac{3}{4}$ in the length; the interspace between dorsals $3\frac{2}{5}$ to 4.

The color of the upper part is brown, sometimes continued down over the sides and belly, almost entirely masking the silvery of those parts. In other specimens, the sides and belly are bright silvery without brown tinge. The fins are all dusky, in some specimens much darker than in others; the ventrals sometimes narrowly edged with bright white.

---

[1] Dr. Jordan has kindly re-examined the specimens here referred to, collected by Gilbert at Panama on a previous expedition, and states that the head measures $4\frac{1}{5}$ (not $4\frac{1}{2}$) in length to base of caudal.

We have been tempted to consider this species the male of *G. dasycephalus*, as our numerous specimens seem to be all males, while our specimens of *G. dasycephalus*, as well as all those of which we have record, seem to be females. The structural differences are so much greater in amount than are known to be sexual with any other species, that we hold the two forms distinct. In addition to the striking difference in the length and sculpturing of the head, *G. longicephalus* has shorter barbels, coarser gill-rakers, shorter pectoral spines, a wider fontanel, and a wider snout and mouth.

38. **Sciadeichthys troscheli** (*Gill*).

Abundant along the entire coast of Mexico and Central America. At Panama it occurred daily in the markets, but seldom in large numbers. The collection contains five specimens from Panama, one from Champerico.

The species varies in certain respects more than has been represented. The dorsal buckler varies much in width, and even in general shape; one specimen at hand has it triangular, tapering nearly uniformly from the base forward to the long acute apex, two-fifths of its length on the median line being contained within the notch of the occipital process. In one individual, the granulations are very sparse, and largely obscured by the thickened integument.

The maxillary barbels are blackish, with a conspicuous white inferior margin. They vary much in length, often failing to reach opercular opening, sometimes overlapping base of pectoral spine. The vomerine patch of teeth is sometimes long (transversely) and narrow, thus separating widely the palatine bands (as figured by Eigenmann and Eigenmann, 1890, p. 56); sometimes much shorter and wider. The head seems very constant in length, 3⅓ to 3⅙ in total length (without caudal).

39. **Selenaspis dowi** (*Gill*).

Large specimens are frequently brought into the Panama market, but seldom more than two or three at a time. The young are rarely seen. In one of the specimens at hand, a curious variation is observable in the shape of the dorsal shield, which has its anterior margin medially produced and wedge-shaped, fitting into an emargination in the occipital process, much as in *Sciadeichthys troscheli*.

40. **Netuma kessleri** (*Steindachner*).

One of the most abundant species of catfishes at Panama. It varies in color from light brown to nearly black on the upper parts, and may be pure white below or variously marked with brown. The fins vary in a similar manner, the caudal, anal, and inner surfaces of pectorals and ventrals being black in the darkest specimens, merely dusky in others. The vomerine patches vary somewhat in size and shape. A very narrow groove may be detected, separating them in all of the specimens, and they do not seem to be wholly confluent with the palatine patches even in adults. The pterygoid bands may be wholly absent, or represented by a linear group of small patches, or fully developed as an elliptical patch of large size.

Nine specimens were preserved.

41. **Netuma insculpta** (*Jordan & Gilbert*).

Hitherto known only from the type (an adult male) and two young co-types, all from Panama. To these, the present collection has added an adult female, 27 cm. long.

The species is very close to *N. planiceps*, but differs in its wider head, more numerous and coarser granulations, wider occipital process, longer barbels, and shorter higher adipose fin. The occipital process is less sharply keeled, and the palatine teeth are in larger patches. In our specimen, the vomerine patches are large, the apposed magrins rounded, meeting in the middle but not confluent; evident furrows mark them off from the palatine patches. The latter are very large, with straight parallel inner edges, as in *N. platypogon*.

In the following measurements the specimen varies somewhat from the type description:

Head 3¾ in length. Interocular width 2⅙ in head; snout 2⅗; width of mouth (external measurement) 2; maxillary barbel reaching to end of second fifth of the length of the pectoral spine; outer mental barbel to little past gill-opening. Occipital process a little wider at base than its length on the median line. Length of predorsal plate on the median line one-third the length of one of its sides. The base of the adipose fin is contained 2¾ times in the head, its height 1¾ in its length. The ventrals overlap the rudimentary anal rays. The anal has 14 developed rays, 3 rudiments. The posterior face of the pectorals is black, the other fins dusky. The maxillary barbel is silvery white, with a black upper margin.

42. **Netuma planiceps** (*Steindachner*).

Of frequent occurrence. This proves to be an extremely variable species, the variations not being dependent on age or sex, and not correlated. The occipital process may be very much narrower than figured by Steindachner (1876 *b*, Pl. IV), more tapering posteriorly; or it may be broader than there represented and more expanded at the base, so that the lateral margins are more concave and the greatest width and length of the plate are about equal. There is usually a wide shallow groove extending backward from the fontanel to within about a pupil's diameter of the occipital process. This is often obscured posteriorly by granules or granulated ridges, and may even be obliterated by the latter, as shown in the figure already cited. The carina on the occipital process is usually sharp, rarely rounded posteriorly. In the former case it is not infrequently continued backward onto the dorsal plate. The granulations are always very fine; they are sometimes arranged in series, and are always rather distant and inconspicuous.

The teeth on the palate are especially variable. The vomerine patches are usually small, and may be either confluent with each other and with the palatine patches, or may be separated from both by a groove. This variation seems to be not determined by age. The palatine patches are sometimes ovate, small, with very indistinct backward processes; sometimes fully twice as large, produced backward, with their inner margins nearly straight and diverging.

The snout is usually broadly rounded or subtruncate, seen from above. In some cases, however, it is sharply convex, the mouth then with more lateral cleft, and often with swollen lips. In all the specimens, the premaxillary band of teeth is long, its width being contained not less than four times in the length. The barbels are always short, the maxillary barbel seldom reaching the gill-opening. In adults, the appearance is often peculiarly modified by the great enlargement of the upper portion of the cheek muscles, making the top of the head transversely concave.

The long adipose fin is highest near its middle, where the vertical height is about one-third the length. The fin is not wholly adnate, there being a short, free posterior border. It is constantly a little longer than the base of the first dorsal.

43. Netuma platypogon (*Günther*).

Abundant in the Panama market. Of the ten specimens preserved, six are females, with elongate ventrals, which overlap the front of the anal. Unlike *G. eigenmanni*, the vent is constant in position, not more anteriorly placed in females. As in *G. eigenmanni* and *G. jordani*, the inner ventral ray is somewhat broadened in females, and gives attachment to a dermal thickening, less marked, however, in this species.

In one male specimen taken at some date between January 10 and February 24, the mouth contained eggs, and was obviously functioning as a brood-cavity. The strong arch to the buccal roof was evident. It is clear that the breeding season is not confined to June and July, as given by Steindachner (1876 *b*, p. 17).

N. platypogon has the basal portion of the paired fins jet black on their upper surfaces, in both males and females. The anal is blackish in its anterior two-thirds, with a wide white margin. The fontanel groove is everywhere sharply defined. It is widest a little in front of the middle of its length, tapering slowly backward to the base of the occipital plate, the base of which is always reached. Anteriorly, it narrows more rapidly, terminating in an acute point which is opposite or in advance of the middle of the eyes.

The dorsal spine is very narrowly compressed, its anterior margin sharp, strongly serrate.

44. Netuma oscula (*Jordan & Gilbert*).

Two specimens are distinguishable from *N. planiceps* only by the smaller mouth and the shorter band of premaxillary teeth. The width of the latter (antero-posteriorly) is contained but three times in its length. One specimen is a young male, the other an adult female with very narrow convexly curved snout, and small convex mouth with thick lips. The adult agrees exactly with adults of *N. planiceps*, except in the characters mentioned. *N. oscula* may represent an extreme variation in that most variable species, but the two forms are retained until intermediate specimens are obtained.

It is doubtful whether the specimen described by Eigenmann and Eigenmann (1890, p. 74) as *Tachisurus osculus* is properly referred to this species, as the mouth is wider (two in head), and the intermaxillary band is wider antero-posteriorly, its width one-fourth its length. The vomerine patches seem also much more widely separated than in *N. oscula* or *N. planiceps*. In our adult female the head is contained $3\frac{2}{5}$ times in total length (without caudal).

45. **Netuma elattura** (*Jordan & Gilbert*).

Known from the type specimen obtained by Dr. Gilbert at Panama in 1881; and from another obtained at Albatross Station 2800, Bay of Panama, at a depth of seven fathoms (Jordan and Bollman, 1889, p. 179).

46. **Tachysurus steindachneri** sp. nov.

PLATE V, FIG. 9.

Arius melanopus STEINDACHNER, 1876 *b*, p. 29 (Panama); not *Arius melanopus* GÜNTHER (Rio Motagua, Atlantic slope of Guatemala).

It has been pointed out by Dr. Steindachner, in the article above cited, that Panama specimens of *Tachysurus*, allied to *T. melanopus*, differ not a little from Günther's description of that species. Two specimens in the present collection, 21 (♂) and 26 (♀) cm. long, agree with those examined by Steindachner. They differ from *melanopus* in the shorter head ($4\frac{1}{3}$ in *melanopus*), the character of the longitudinal groove on top of head ("indistinct, narrow, linear behind, scarcely extending to the base of the occipital process" in *melanopus*), the shorter maxillary barbels (not quite extending to the middle of the pectoral fin, in *melanopus*), and in the small size of the axillary pore ("nearly as wide as a nasal opening" in *melanopus*). The description of *melanopus* is so lacking in detail that other differences may well exist. When to these considerations is added the fact that *melanopus* belongs to the Atlantic fauna, while no species of marine catfish is as yet known to be common to the two oceans, it seems advisable to recognize the Pacific form as distinct.

Of the Pacific species, *T. steindachneri* is most nearly allied to *T. liropus*, but the latter has the inner faces of the paired fins light or slightly dusky, instead of black on basal half; the spines are longer and more slender, the snout longer and more rounded at its extremity, the anterior divergent extensions of the granulated area on top of head are much wider, and the nature of the lengthwise groove is widely different.

Type, ♂, 21 cm. long.

Head $3\frac{3}{5}$ in length to base of caudal; depth 5. Greatest width of head $\frac{3}{4}$ its length; interocular width $2\frac{1}{3}$; snout 3; width of mouth (at outer angles) $2\frac{1}{3}$; eye $5\frac{1}{2}$; pectoral spine $1\frac{3}{5}$. Anal with 22 rays, including anterior rudiments.

Head narrow, the occiput slightly depressed opposite the upper angle of the operele. Snout narrow, depressed, subtruncate anteriorly. Top of head with a very few minute granules, most numerous on the occipital plate, where they are more or less confluent to form wavy irregular lines. The occipital plate is wider than long by the diameter of the pupil; its posterior half is narrow, the lateral margins being strongly concave; the median ridge is very low, disappearing behind. The median line of the head is occupied by a sharply defined deep groove, which is continuous from a point opposite the posterior nostrils to a point distant from the base of the occipital plate by the diameter of the pupil. This cutaneous groove is much narrower than the fontanel depression which it traverses, and widens or narrows independently of the latter. Its widest points are at the anterior end of the groove and at the anterior end of its posterior third. There are no strongly marked striæ parallel with the posterior portion of the groove. In no other species of *Tachysurus* known to us is there a continuous groove occupying the fontanel depression. In *T. furthii* the groove may be continued for a short distance in front of the sculptured area, and is then interrupted in the interorbital region, to reappear anteriorly as a short narrow linear depression. *T. emmelane* has also a short detached anterior portion; and this is even shorter, almost round, in *T. liropus*. In the type of *T. steindachneri*, the granulated area on top of head does not send forward diverging processes, the line connecting the middle of the orbits being equidistant from the front of the granulated area and the posterior nostrils. In the co-type, some granulations accompany very narrow diverging ridges, which reach the middle of the interorbital space.

The teeth are similar to those in other species of the genus. The palatine patches are large, well separated, of very coarse granular teeth. The maxillary and mandibular bands are wide, of villiform teeth except for those forming a backwardly projecting lobe near mandibular symphysis; these being coarsely granular.

Eye large, $2\frac{2}{5}$ in interorbital width. The maxillary barbel extends beyond pectoral pore to end of basal sixth of the spine. The outer mental barbels reach to opposite base of pectoral spines, the inner barbels being half their length. The pectoral pore is a narrow slit scarcely half the length of nostril. The branchiostegal membrane has mesially a very narrow, free fold (not to be made out in the co-type). Gill-rakers slender, 5+12, the longest half the diameter of the orbit.

The pectoral spines are short and heavy, their width at base $\frac{1}{10}$ their length, which is half the distance from margin of branchiostegal membrane to insertion of ventrals. The outer edge of the spine is weakly serrate near tip, minutely tuberculate elsewhere; the inner margin is provided with rather small, closely appressed teeth. The dorsal spine is broken in the type, $\frac{2}{3}$ the length of the head in the co-type, the dorsal rays projecting well beyond it. The base of the adipose dorsal equals $\frac{1}{4}$ the length of the head. The sexual orifice is very slightly nearer base of inner ventral rays than front of anal. In the (male) type, the ventrals fail to reach front of anal by $\frac{1}{3}$ their length; in the female specimen they slightly overlap it.

Light grayish brown above, with greenish and bluish reflections; silvery below. Inner faces of paired fins uniformly black in type (male), the basal half only blackish in the female. Anterior half of ventrals dusky.

47. Tachysurus emmelane *Gilbert.*

PLATE VI, FIGS. 11 and 11*a*.

Tachysurus emmelane GILBERT, JORDAN & EVERMANN, 1898, p. 2785.

Head $3\frac{2}{5}$ in length ($4\frac{1}{10}$ in total); depth 5 (6 in total). A. 27 (3+24). Eye 7 in head, $2\frac{1}{2}$ in its distance from tip of snout, 4 in postorbital part of head, $3\frac{2}{3}$ in interorbital width, $2\frac{1}{6}$ in frontal width opposite middle of eyes. Mouth of moderate width, gently convex, the distance between its angles (measured internally) $2\frac{1}{5}$ in head.

Teeth in premaxillary and front of mandible finely villiform; posterior mandibular teeth stronger than those in front, bluntly conic, not, however, coarsely granular, as are the posterior mandibular teeth in *T. furthii*, *T. melanopus*, and *T. liropus*. Mandibular bands with a wide interspace mesially, each widest near symphysis, rapidly tapering laterally, and extending beyond angle of mouth. The width of the bands is less than in related species, $\frac{1}{4}$ eye at their widest point. The length of one of the mandibular bands is slightly greater ($1\frac{1}{10}$) than length of eye. Premaxillary band very short, its length but $\frac{1}{6}$ greater than that of one of the mandibular bands, extending on each side less than $\frac{1}{2}$ distance from median line to angle of mouth; width of band $\frac{1}{5}$ its length. Palatine teeth granular, in small oblanceolate patches, which taper to a point laterally, and are widely separated on median line, the patches agreeing in size and shape with those in *T. liropus*.

Head depressed, tapering, and at the same time narrowing anteriorly, as in other species of *Tachysurus;* profile rising in a uniform, gently convex curve to occiput, where it becomes concave, owing to the more rapidly ascending outline of the occipital process. Eye low, but little above angle of mouth, the interorbital space decidedly convex. Barbels slender, the maxillary barbels reaching edge of gill-membrane in front of pectoral spine, the outer mental barbels extending beyond gill-membrane, $1\frac{4}{5}$ in head; the inner not to edge of membrane. Gill-membrane widely attached to isthmus, without free edge.

Occipital region with very fine granulations, those on middle of occiput forming parallel series along the fontanel groove, those on median portion of occipital process in series which diverge backward from the median line. The sculptured area extends forward to a vertical which traverses the cheek at a distance of its own diameter behind the eye; anterior edge of granulated area equidistant between the tip of snout and front of predorsal plate. Fontanel produced backward as a deep, narrow groove, which fails to reach base of occipital process by a distance equaling half the length of the process on the median line. The groove widens but little anteriorly; an area behind and on each side of the groove with parallel series of granulations, and marked off from the rest of the head by a shallow trench. Base of occipital process similarly indicated by a transverse indented line; occipital process not keeled, very wide at base, becoming abruptly very narrow behind, its posterior third having parallel margins and being as wide as long, the lateral margins therefore deeply concave; width of process at base equaling its length on median line plus that of predorsal plate, its hinder edge deeply incised to receive the anterior rounded wedge-shaped process of the predorsal plate. The latter is finely granulated anteriorly, the lateral wings concealed under the smooth skin. A narrow groove as long as eye occupies the anterior end of the fontanel. Opercle without radiating ridges. A short, slit-like axillary pore present. Humeral process short, the exposed portion not broadly triangular, the surface smooth, or indistinctly rough. Gill-rakers 6+13, of moderate length and thickness, the longest below the angle, $\frac{2}{3}$ diameter of eye.

Dorsal spine with a series of obtuse granulations in front and very weak retrorse serræ behind, its length to tip of calcified portion $1\frac{2}{5}$ in head; longest soft ray $1\frac{2}{5}$ in head. Adipose dorsal not adnate, its anterior insertion about over middle of anal; base of adipose dorsal much greater than its height, less than base of first dorsal; distance between dorsals equal to length of head. Pectoral spine strong, ridged and granulated in front, the hinder edge with very strong serræ; length of spine $1\frac{3}{4}$ in head, the fin projecting beyond tip of spine and reaching $\frac{2}{5}$ distance from axil to base of ventrals. Ventrals reaching to or nearly to origin of anal. Vent midway between base of ventrals and front of anal. Base of anal equaling length of pectoral spine, its margin gently concave, the longest ray $2\frac{2}{3}$ in head. Caudal with pointed lobes, the lower longest in the type, $1\frac{2}{5}$ in head.

Color dark steel blue or brownish above, becoming bright silvery below; posterior $\frac{2}{5}$ of anal white, the anterior portion black with a narrow white edge; pectorals and ventrals with anterior (outer) face white or slightly dusky; pectorals with inner face of upper rays black; a black blotch covers all of inner face of ventrals except terminal half of inner rays; barbels blackish.

Closely related to *T. melanopus* and *T. multiradiatus*, differing from the former in the longer anal fin, from the latter in the black markings on lower fins.

The description of the type of *T. multiradiatus* (*Bagrus? arioides*) Kner & Steindachner (1864, p. 47), indicates a species with much rougher sculpturing of the head, a longer fontanel groove, narrower occipital process, and more anteriorly inserted adipose dorsal.

The type is a single specimen, 280 mm. long, from Panama.

48. Tachysurus furthii (*Steindachner*).

Abundant, eighteen specimens preserved. Our specimens exhibit some variation in the size of the granulations on top of head, also in the extent of the granulated area, which sometimes extends as far forward on the ridges as the posterior border of the eye. The groove extending backwards from fontanel is variously developed. An occasional specimen shows no trace of the groove; others have it developed for half the distance to the occipital process; in most cases it nearly reaches the base of the latter. In the interorbital region, the fontanel depression contains no definite groove, but at the anterior end of the depression, a short oval detached portion of such groove is always present.

The interspace between dorsals is found to be $3\frac{1}{2}$ to 4 in the length, not "3 to $3\frac{1}{3}$" as given by Eigenmann. The species stands alone in the delicate, easily ruptured skin, and the very light blue color of its upper parts.

49. Tachysurus evermanni sp. nov.

PLATE V, FIG. 10.

Type, 252 mm.; Panama Bay; C. H. Gilbert and party, collectors; No. 6706, Ichthyological Collections, L. S. Jr. U.

Very close to *T. furthii*, from which it differs in the subequal jaws (the upper much protruding in *furthii*), the thick, gently rounded snout (thin and subtruncate in *furthii*), the shorter barbels, the coarser granulations on head, the absence of a depressed linear pit at anterior end of fontanel depression (this always present in *furthii*, representing a detached anterior portion of a fontanel groove), and the much wider union of gill-membranes with the isthmus.

Head $3\frac{3}{8}$ in the length; depth $4\frac{1}{5}$; tip of snout to front of dorsal $2\frac{1}{2}$; distance between dorsals $3\frac{2}{5}$; distance from base of inner ventral ray to front of anal $6\frac{2}{7}$. Eye 4 in interocular, 8 in head; greatest width of head $1\frac{2}{5}$ in its length; length of snout $2\frac{9}{10}$; width of mouth $2\frac{2}{3}$; distance between anterior nostrils $6\frac{2}{3}$ ($5\frac{2}{3}$ in *furthii*); pectoral spine equaling length of head behind front of pupil; dorsal spine equaling length of head behind posterior margin of pupil; base of adipose fin equaling base of dorsal behind the spine.

The snout is convexly rounded anteriorly, less depressed than in *furthii*. The maxillary barbel barely reaches gill-opening, when laid horizontally backward; the outer mental barbels reach margin of gill-membrane on under side of head.

The palatine patches of teeth are narrowly elliptical, their length $1\frac{1}{5}$ times the diameter of the orbit; they are narrowly separated in front, the interspace $\frac{3}{4}$ diameter of pupil; the inner mandibular teeth next the symphysis are coarsely granular, like the palatine teeth.

Gill-membranes broadly united to the isthmus, without free fold, the width of the complete union with the isthmus more than twice the diameter of the eye (much narrower, less than diameter of eye in *furthii*). Gill-rakers rather strong, 5+9, the longest $\frac{2}{3}$ the diameter of the eye.

Top of head much more coarsely granulated than in *furthii*; the groove is confined to the granulated area, terminating at a point $\frac{2}{3}$ diameter of pupil in front of the base of the occipital process. Anteriorly, the fontanel depression is evident, but contains no definite groove at any point. The occipital process is very broad, wider at base than long, much shorter than in *furthii*, the median portion not elevated as in the latter; a raised line representing an obsolescent keel is present on the median line of the anterior two-thirds. The predorsal plate is narrow, sculptured like the occiput on its anterior transverse portion only.

The dorsal and pectoral spines are slender, rugose anteriorly, but without teeth except near the tips; the teeth on the posterior margin of the dorsal spine are scarcely visible, being smaller than in *furthii*; the inner pectoral teeth are stronger and less numerous than in *furthii*. The type is a male, with the ventral fins failing to reach the front of the anal by half their length. The vent is midway between ventrals and front of anal. The pectoral pore is small, slit-like.

The skin is thicker and less delicate than in *furthii*, and the color is darker, the upper parts dark brownish, with obscure bluish reflections. Barbels all more or less dusky.

50. **Tachysurus multiradiatus** (*Günther*).

Not seen by us. The type specimen was recorded by Kner & Steindachner, 1864, p. 227, as *Bagrus ? arioides*, from the Rio Bayano near Panama. A second specimen has now been listed by Boulenger, 1891, p. 2, from Rio Cianati, Darien.

51. **Cathorops hypophthalmus** (*Steindachner*).

Known only from the types, and from two specimens secured by Gilbert in 1881; all from Panama.

52. **Cathorops gulosus** (*Eigenmann & Eigenmann*).

Two specimens were secured, 230 and 245 mm. long. None others are known save the types, from Panama, which are in the Museum of Comparative Zoology.

Our specimens agree for the most part with Eigenmann's description. The following details may be placed on record:

Head $3\frac{3}{7}$ or $3\frac{1}{2}$ in length; distance from tip of snout to origin of dorsal, $2\frac{1}{2}$; distance between dorsals $3\frac{2}{3}$ or $3\frac{3}{8}$. Interocular space 2 in head; width of mouth, measured at outer angle of lips, $2\frac{1}{3}$ or $2\frac{5}{8}$; length of dorsal spine $1\frac{1}{4}$ to $1\frac{1}{3}$ in head; upper caudal lobe $1\frac{1}{3}$; longest anal ray $2\frac{1}{4}$; ventrals 2 or $2\frac{1}{5}$. The retrorse teeth on inner border of dorsal and pectoral spines are minute, irregular, crowded. The maxillary barbels extend to distal fourth of pectoral spine; outer mental barbels to its middle, inner mental barbels to its base. The fontanel groove fails to reach the base of the occipital process by $\frac{3}{4}$ the diameter of the eye. The palatine patches of granular teeth are wider than figured by Eigenmann, the two separated by a distance equal to or slightly in excess of the diameter of the eye. The patches vary in size and shape in the two specimens, and on opposite sides of the same individual. In one specimen are two detached teeth laterally on the head of the vomer, on one side only; none in the other specimen.

In addition to the other characters already noted, *Cathorops* differs from *Tachysurus* in the absence of the patch of coarsely granular teeth along the inner border of the symphysial portion of the mandibular band.

Family SYMBRANCHIDÆ.

53. **Symbranchus marmoratus** *Bloch.*

Abundant in a fresh-water pond at Miraflores, where it is trapped for food. As none could be taken with the seine, it seems probable that the species burrows in the mud. The few specimens secured were all brownish, variously marbled with yellowish.

Family LEPTOCEPHALIDÆ.

54. **Congrellus gilberti** *Douglass-Ogilby.*

Congrellus gilberti DOUGLASS-OGILBY, 1898, p. 288.
Ophisoma (?) balearicum GILBERT, 1891 *a*, p. 349.

Dredged by the "Albatross," Station 2797, Panama Bay, 33 fathoms; recorded by Gilbert as *Ophisoma* (?) *balearicum.* The species is based exclusively on Gilbert's description above cited. The type specimens are deposited in the United States National Museum.

55. **Congrellus nitens** (*Jordan & Bollman*).

One specimen dredged by the "Albatross" in Panama Bay, Station 2799, $29\frac{1}{2}$ fathoms (Gilbert, 1890 *b*, p. 450).

56. **Congrellus proriger** (*Gilbert*).

A co-type of this species was dredged by the "Albatross" in Panama Bay, Station 2799, $29\frac{1}{2}$ fathoms (Gilbert, 1891 *a*, p. 35).

Family MURÆNESOCIDÆ.

57. **Muræesox coniceps** *Jordan & Gilbert.*

Safiro.

The most abundant eel at Panama, where it appears in the market nearly every day. The relations of the species to its Atlantic representative *M. savanna* are much in need of elucidation.

58. **Neoconger vermiformis** *Gilbert.*

"Albatross," Station 2799, Panama Bay, 29½ fathoms (Gilbert, 1890 *b*, p. 450).

Family MYRIDÆ.

59. **Myrophis vafer** *Jordan & Gilbert.*

Numerous in rock-pools, from which several specimens were obtained, larger than any before recorded. The teeth are in a moderate band in upper jaw, narrowing backward, and widening rapidly in front, where it becomes confluent with the patch at anterior end of vomerine series. Behind this, the vomerine teeth are in a single series, which is continued backward to behind angle of mouth. Mandibular teeth in a single series laterally, widening into a band at symphysis. In *M. punctatus* all the bands of teeth are wider, and those of vomer and mandible are in more than one series.

Table of Measurements in Millimeters.

Total length.	Head and trunk.	Tail.	Head.	Length of snout.	Width of snout.	Gape.	Eye.	Length of pectoral	Width of pectoral base.	Length before dorsal.
280	108	172	31	5	4	8½	2	5	2½	65
215*	98	117*	28½	4½	3¼	8	2	4½	2	59
210	81	129	23	3½	3	6	2	3½	1½	49

Family OPHICHTHYIDÆ.

60. **Myrichthys tigrinus** *Girard.*

Ophisurus xysturus Jordan & Gilbert, 1881 *c*, p. 346.

Numerous specimens were obtained from tide-pools on the reef. They answer Girard's description of the type, and also the type description of *O. xysturus*. The number of rows of teeth on sides of mandible varies from two to four, younger specimens having frequently the lower number. The head varies in length, being contained 3⅓ to 4¼ times in the trunk. There are but two conspicuous series of roundish spots on either side of the back, a third series of much smaller spots being only occasionally present along base of anal fin. The spots on head vary greatly in size, number and position. No arrangement can be assigned to these as normal for the species.

---

* Tail in this specimen evidently injured, though surrounded by the fin.

61. Pisoodonophis daspilotus *Gilbert.*

PLATE VII, FIG. 12.

Pisoodonophis daspilotus GILBERT (JORDAN & EVERMANN, 1898, p. 2803).

Brownish above, gray below, the head and body usually thickly covered with black spots smaller than the eye; these are smaller and more numerous on the head, fewer and fainter on the lighter inferior surface, and become indistinct or entirely disappear on the terminal portion of tail. In one specimen the head and trunk are spotted and the entire tail unicolor. In another no spots are present, the upper parts being a uniform dark brown, the under parts lighter brown, a few dark freckles only being present on sides of head. In all specimens the snout and lower jaw are blackish.

The anus is near the middle of the total length, sometimes nearer the tip of snout, sometimes nearer tip of tail. The cheeks are not greatly swollen. The gape extends behind the eye, its length, measured from tip of lower jaw to angle of mouth, being contained 4⅗ to 4¾ in head. The snout projects beyond the lower jaw for a distance about equaling diameter of orbit. Eye 2 to 2⅓ in snout, 1⅔ to 2¼ in interorbital width. Tubes of anterior nostrils about ½ diameter of eye, directed downward near tip of snout. Posterior nostrils under front of eye, concealed in the upper lip as usual.

Teeth all bluntly conic, in rather wide bands on jaws and vomer; they are usually not disposed in regular series within the bands, but each band has about the width of four series, and these are sometimes distinguishable. The mandibular teeth become larger on approaching the symphysis, those at point of mandible and those on head of vomer being much the largest teeth present. The patch on shaft of vomer tapers backward to a point considerably behind angle of mouth.

Origin of dorsal entirely behind tip of pectorals, its distance from snout ⅓ to ⅛ greater than length of the head. The tip of the tail is compressed, acute, horny, used for defense. Pectoral very short, from a wide base which slightly exceeds length of gill-slit. The fin rapidly narrows downward, the longest portion contained 12 to 14 times in length of head. The width of gill-slit is about ⅛ head.

Table of Measurements in Millimeters.

Total length.	Head and trunk.	Tail.	Head.	Gape.	Eye.	Interorbital width.	Width at cheeks.	Length of snout.	Projection of snout beyond mandible.	Length of pectoral.	Basal width of pectoral.	Distance from snout to dorsal.	Vertical height of dorsal.	Depth of body.
362	177	185	38	8	3	5	9½	6¼	2¾	3½	5	48	3	12
401	203	198	48	10½	3½	7	11	7½	3½	4	6	53	4	14½
492	248	244	52	11	3½	7½	16½	8¼	3½	3¾	6¼	68	5½	18
494	255	239	56	12	4¼	7	16	8½	4½	4	6	68½	5½	16

Four specimens were secured, three obtained in brackish water at the mouth of a small stream which empties into Panama Bay, the fourth in a fresh-water pond at Miraflores. There is some reason to suppose that they burrow in the mud.

62. **Ophichthus triserialis** (*Kaup*).

No Panama record is known to the writers. The species is abundant on the Mexican coast, and has been recorded from the Galapagos Islands (GILBERT, 1890*b*, p. 450).

63. **Ophichthus zophochir** *Jordan & Gilbert.*

This species has been heretofore known only from the Mexican coast (Guaymas, Mazatlan, Acapulco). A single specimen was taken in a rock-pool at Panama. As in the type, the teeth are acute, biserial on all the bones. The color is as described, except that the dorsal is not definitely black-edged. The anal is conspicuously edged with black, the pectoral largely blackish. Pores on head black-edged.

Table of Measurements in Millimeters.

Total length.	Head and trunk.	Tail	Head.	Snout.	Eye.	Gape	Projection of snout.	Pectoral.	Distance from snout to origin of dorsal.
329	114½	214½	37	6¼	4	12½	2	19	49

Family MURÆNIDÆ.

64. **Rabula panamensis** (*Steindachner*).

Recorded from Panama by Steindachner, and by Boulenger (1899, p. 2), as *Muræna panamensis;* not seen by the writers.

65. **Lycodontis verrilli** (*Jordan & Gilbert*).

Only the type specimen known; collected by Prof. F. H. Bradley at Panama in 1866; now in the museum of Comparative Zoology.

66. **Lycodontis dovii** (*Günther*).

A single specimen 753 mm. long was taken in a tide-pool on the reef at Panama.

The color is dark chestnut-brown, uniform on head, body and fins, except that the belly and under side of head are lighter. The spots are numerous, round, varying in size, but all of them small, the largest smaller than pupil; they were all very light yellow in life, and are not definitely ocellated, the ground-color being slightly darker around them. The larger spots are on the dorsal portions, with occasional finer ones intermingled; those on ventral surface minute. Fins colored like the body, the spots of the same size and character. On the head the spots become less numerous, the anterior third of its length plain.

Teeth everywhere in single series, the lateral teeth small, those anteriorly in both maxillary and mandible much enlarged. Shaft of vomer with a very inconspicuous series of teeth, beginning opposite middle of eye, preceded after an interval by three very large depressible canines, the largest teeth present. A series of five black-edged pores along each half of upper and lower jaw, the two largest on upper jaw between front of eye and anterior nostril tube.

Table of Measurements in Millimeters.

Total length.	Head and trunk.	Tail.	Head.	Gape.	Snout.	Eye.	Depth at anus.	Distance from origin of dorsal to snout.
753	336	417	103	44	19	7	50	78

67. Muræna clepsydra *Gilbert.*

PLATE VII, FIG. 13.

Muræna clepsydra GILBERT (JORDAN & EVERMANN, 1898, p. 2805).

Muræna melanotis GÜNTHER, Cat. Fish., Vol. VIII, p. 98 (in part); here belong all other records of *M. melanotis* from the Pacific.

Closely related to *M. insularum* and *M. argus*, from the tropical Pacific, but differing from both in color.

Nostrils tubular, of almost equal length. Mouth closing completely, the teeth entirely concealed by the lips. Gape straight, horizontal, extending to well behind the eyes, $2\frac{1}{3}$ to $2\frac{3}{4}$ in head.

Teeth in jaws large, compressed and wide at base, tapering uniformly to an acute point, directed backward, close set, everywhere uniserial; those in sides of mandible noticeably smaller than those of upper jaw, the teeth in both jaws increasing in size anteriorly. As many as 18 or 20 teeth may be present in the half of either jaw, but many of them are usually wanting, leaving gaps in the series. A single row of small teeth on shaft of vomer, beginning opposite front of eye. Head of vomer with two long canines, larger than any of the other teeth, one or both of these usually wanting in larger specimens, having apparently fallen out.

Head 2 ($1\frac{11}{12}$ to $2\frac{1}{12}$) in trunk; head and trunk $1\frac{1}{3}$ to $1\frac{1}{7}$ in tail; depth at anus approximately half length of head. Eye small, its diameter contained 12 to 16 times in head; snout 5 to $5\frac{1}{3}$. Dorsal beginning on the head, its distance from snout $1\frac{1}{3}$ to $1\frac{1}{2}$ in head.

Color dark brown, lighter on belly, dull whitish on under side of head. Head, body and fins closely covered with white spots, those on posterior parts larger, with some smaller ones intermingled, the larger spots with a more or less evident central constriction which makes them hourglass-shaped. Toward the head, the spots become very small and crowded, not more than half as large as pupil. Fins indistinctly light margined. A large elliptical jet-black blotch surrounds the gill slit, distinctly margined by a series of confluent white spots. The longitudinal diameter of the blotch is contained 5 to $5\frac{1}{2}$ times in the length of the head. Angle of mouth with a small black blotch, often obscure, preceded by a pale spot on mandible. The throat is marked with a number of parallel lengthwise folds, the bottom of each fold with a dark line.

Table of Measurements in Millimeters of Five Specimens.

Total length.	Head and trunk.	Tail.	Head.	Gape	Snout.	Eye.	Depth at anus.	Distance from snout to origin of dorsal.
675	311	364	106	45	20½	7	59	72
630	289	341	96	38	18½	6¼	52½	70
612	287	325	98	39	19	6¼	47	64
473	203	270	66	28	13	5¾	40	50
397	177	220	58	21	11	4½	27	39

This species is abundant at Panama, where it is frequently brought to market. About 25 specimens were seen during the visit of the expedition, all essentially alike in coloration. The type is 397 mm. long (see table of measurements), and has the spots on body less numerous than in larger specimens.

68. **Muræna lentiginosa** *Jenyns.*

Originally described from the Galapagos Islands, this species seems much more abundant in Mexico, toward the northern limits of its range. No specimens were seen by the authors, the single Panama record being by Rowell (JORDAN & GILBERT, 1882 *l*, p. 381).

Family ELOPIDÆ.

69. **Elops saurus** *Linnæus.*

This species was occasionally seen, but was not abundant.

Family ALBULIDÆ.

70. **Albula vulpes** (*Linnæus*).

Not abundant. A few specimens only were seen in the market.

Family CLUPEIDÆ.

71. **Sardinella stolifera** (*Jordan & Gilbert*).

The species is apparently not abundant at Panama, as but two or three small specimens were seen. It is now known to extend as far south as Guayaquil (BOULENGER, 1898-9, Vol. XIV, p. 1).

72. Opisthonema libertate (*Günther*).

Abundant; several specimens preserved averaging about 25 cm. long. Young specimens were also seen at Acapulco.

This species differs from *O. oglinum* in coloration, in the shorter dorsal and anal fins (the latter containing 20 or 21 rays), and in the more numerous gill-rakers. The alleged differences in length of head are not reliable, both species varying greatly in this respect and no average difference being evident.

Six specimens of *O. libertate* give the following measurements:—

Head in length.	Depth in length.
$3\frac{2}{3}$	$2\frac{4}{5}$
$3\frac{2}{5}$	$2\frac{7}{8}$
4	$3\frac{2}{7}$
$4\frac{1}{10}$	3
$4\frac{1}{6}$	$3\frac{1}{10}$
$4\frac{2}{7}$	$2\frac{9}{10}$

In addition to the details of coloration already reported there is frequently present a series of small, round, evenly-spaced dark spots, behind the humeral spot, along the line separating the blue of the back from the silvery of the sides. Scutes 18+14 or 15.

73. Ilisha furthi (*Steindachner*).

Pellona furthi STEINDACHNER, 1875*a*, p. 14.
Pellona panamensis STEINDACHNER, l. c. p. 14.

A very abundant food-fish at Panama, but of inferior quality. The species is extremely variable in shape, but the deepest forms with strongly arched ventral outline (*I. furthi*) grade imperceptibly into the more slender forms with weak ventral curvature (*I. panamensis*). No other characters are correlated with this difference in ventral curvature, and it appears certain that but a single species is represented. The deeper specimens are constantly the smaller ones, so far as indicated by the material at hand. The eye is therefore proportionately larger, and the snout (measured into the eye) apparently shorter than in the larger, slenderer individuals. In none of the specimens do the first five to seven anal rays originate under the dorsal fin, as described in *I. furthi*. In both deep and slender forms the first anal ray is approximately under the last of the dorsal. The front of the dorsal is constantly nearer the tip of snout than the base of the caudal, the difference varying from $\frac{2}{3}$ to $\frac{3}{4}$ diameter of orbit.

The following table of measurements exhibits the variation in depth of body, and in size of eye and snout. The length into which the depth of body is measured, is taken from the tip of snout to base of caudal, excluding the projecting tip of lower jaw. Steindachner has apparently included the latter in his measurements.

Total length in millimeters.	Depth into the length.	Orbit into head	[illegible]
255	2[illegible]	2[illegible]	1[illegible]
280	$2\frac{4}{5}$	2[illegible]	[illegible]
295	$2\frac{4}{5}$	2[illegible]	[illegible]
295	2[illegible]	3	$1\frac{1}{3}$
305	3	3	1[illegible]
310	$2\frac{3}{4}$	3	1[illegible]
320	$3\frac{1}{2}$	3[illegible]	$1\frac{1}{4}$
330	3[illegible]	$3\frac{1}{4}$	$1\frac{1}{5}$
390	3	$3\frac{1}{2}$	1

74. Opisthopterus dovii (*Günther*).

This species is known only from Panama, where it occurs but rarely. Four specimens were seen, 18 to 20 cm. long; they agree well with Günther's diagnosis. Head $4\frac{4}{5}$ to 5 in length; depth $3\frac{1}{3}$ to $3\frac{1}{2}$. Eye $3\frac{1}{3}$ to $3\frac{1}{2}$ in head; maxillary $1\frac{9}{10}$ or 2. Pectorals long, pointed, 4 to $4\frac{4}{5}$ in length. Origin of dorsal nearer caudal than scapula by half length of head. A. 55, 59, 61, 62 in our specimens; D. 11, 12, 13, 14. Scutes 27 or 28. Teeth in jaws strong, incurved, in a single series.

Color light olivaceous above, bright silvery below angle of gill-opening. A faint bluish streak sometimes present along upper edge of silvery area. No dark humeral spot. A broad black vertebral band. End of snout and tip of lower jaw black. Fins translucent, with dark specks along the rays.

75. Opisthopterus macrops (*Günther*).

Occurring but rarely. Three specimens were obtained, each about 225 mm. long.

The species is readily distinguished from *O. dovii* by its much larger eye, more oblique mouth, strongly concave occipital profile, and deeper body with much stronger ventral curvature. The teeth are much smaller than in *O. dovii*, and there is a conspicuous humeral spot, lacking in the latter. In the specimens taken, the head is $4\frac{3}{5}$ or $4\frac{2}{3}$ in length, the depth $2\frac{7}{8}$ to 3. Eye $2\frac{2}{3}$ to $2\frac{3}{7}$ in head. Front of dorsal slightly nearer root of caudal than scapula, farther forward than in *O. dovii*. Pectoral $4\frac{1}{2}$ to $4\frac{2}{3}$ in length. Scutes 27. D. 13 or 14. A. 62. Coloration as in *O. dovii*, but with a large black humeral spot.

Not heretofore reported since the discovery of the type at Panama by Capt. J. M. Dow.

76. Odontognathus panamensis (*Steindachner*).

Only the type specimen is known.

Family ENGRAULIDIDÆ.

77. **Anchovia miarcha** (*Jordan & Gilbert*).

Collected by Prof. Frank H. Bradley in the Pearl Islands, Bay of Panama (JORDAN & GILBERT, 1882 *n*, p. 622); not seen by us.

78. **Anchovia ischana** (*Jordan & Gilbert*).

Three specimens taken, the largest 63 mm. long.

79. **Anchovia curta** (*Jordan & Gilbert*).

Numerous specimens were taken. Some of these have the lateral streak "somewhat indistinct," as given in the original description of the species, while others have the streak much better marked, with well-defined edges. It widens on the caudal peduncle and wholly disappears anteriorly.

80. **Anchovia opercularis** (*Jordan & Gilbert*).

A specimen of this species is recorded by Gilbert (1890 *b*, p. 449) from Albatross Station 2802, Panama Bay, in 16 fathoms.

81. **Anchovia lucida** *Jordan & Gilbert*.

Five specimens were taken, the largest 57 mm. in total length.

In the original description of this species the cheek is described as being over half the length of the head. This is evidently a mistake, and should probably read, cheek over half the post-orbital part of the head. This would agree with the specimens taken.

82. **Anchovia rastralis** (*Gilbert & Pierson*).

PLATE VIII, FIG. 14.

Stolephorus rastralis GILBERT & PIERSON (JORDAN & EVERMANN, 1898, p. 2811).

Head 3.16 (3.1 to 3.3); depth 3.8 (3.5 to 4.2); eye 3.4 in head (3.33 to 4). D. 14 (12 to 15) A. 26 to 32. Length 5 to 8 cm.

Body much compressed and deep; belly sharply keeled in front of ventrals; dorsal outline much less curved than ventral. The lower profile rises very rapidly from a point opposite middle of pectorals to tip of snout, the shape of head thus closely resembling that of *Cetengraulis*. Maxillary reaching almost but not quite to gill-opening; snout high, compressed, its length ½ to ¾ diameter of eye. Gill rakers averaging in larger examples 51+64, in smaller specimens 44+50; the largest about as long as eye. Insertion of dorsal fin variable, but never posterior to a point midway between base of caudal and middle of eye; pectoral fins reaching to or nearly to insertion of ventrals; the latter not to vent.

Color olivaceous, the lower part of sides with violet reflections; sides of head silvery; a conspicuous silvery lateral band, varying in width from about one and one-third times length of orbit in the largest examples to less than one-half the orbit in the smaller specimens. The band is widest before dorsal, and tapers to half or less than half its greatest width on caudal peduncle, where it frequently disappears in the young. In larger specimens the ventral edge of this band is frequently ill-defined anteriorly. Top of head with widely spaced black specks. A dark vertebral streak, more or less of which often consists of two narrow lines. Tips of caudal lobes often blackish; fins otherwise unmarked.

Differing from closely allied species in the following characters: From *A. lucida*, in the much longer head, more compressed body, well defined lateral stripe, and smaller eye; from *A. compressa*, in the longer head and wider lateral band; from *A. panamensis* and *A. mundeola*, in the much more numerous gill rakers, and the more anterior position of the dorsal relatively to the anal, the origin of the anal being under the middle of the dorsal, while in *A. panamensis* the origin of the two fins lie in the same vertical.

83. Anchovia naso (*Gilbert & Pierson*).

Stolephorus naso GILBERT & PIERSON (JORDAN & EVERMANN, 1898, p. 2813).

Head 3.3–3.5 in length; depth 4.7–5.8; eye 4.5–5 in head. Anal 22–24; dorsal 14 or 15; lateral line about 35.

Dorsal and ventral outlines weakly arched; body slender, compressed, its greatest depth 1.5 in head; belly carinated in front of ventrals, and sometimes behind them in larger specimens. Head long and slender, its greatest width 1.5 to 1.7 in its length, the lower profile much more oblique than the upper. Snout long, compressed, bluntly rounded, its length exceeding the small eye. Cheek with a very acute posterior angle. Opercle narrow, oblique. Maxillary rather bluntly pointed, failing to reach gill-opening by about one-half diameter of pupil. Teeth on the maxillary quite prominent and directed forward. Gill-rakers short, 17+20 in number; the longest 1½ in eye. Scales large, thin, deciduous, only a few scattering ones remaining on our specimens. Dorsal fin inserted midway between front or middle of orbit and base of median caudal rays. Origin of anal under or slightly behind middle of dorsal; length of anal base about equal to the distance from front of orbit to base of ventral fin. Pectorals not reaching ventrals, their length about one-half length of head. Length of ventrals equaling or slightly exceeding distance from tip of snout to middle of pupil.

Color light olive, with the usual bright reflections; a large dark patch of brown dots on occiput; a double series of dots along median line posterior to dorsal, this absent in some specimens; large specimens with a bright well defined silvery streak, slightly narrowing anteriorly and on caudal peduncle, its greatest width about equaling diameter of eye. In the young, this band is fainter and narrower. A conspicuous series of black dots at base of anal.

Characterized by the slender form, well defined silvery streak, sharply carinated breast, the small eye, and the very long, compressed, deep and rather bluntly rounded snout. Most closely resembling *A. starksi*, from which it differs in smaller eye, longer snout, and slightly longer anal. Length 40 to 52 mm.

84. Anchovia starksi (*Gilbert & Pierson*).

Stolephorus starksi GILBERT & PIERSON (Jordan & Evermann, 1898, p. 2813).

Head 3.3 to 3.6; depth 4.8 to 5.5 in length, 1.3 in head. Eye 3 to 3.5 in head. Dorsal 15 or 16; anal 17 to 22; scales about 41. Vertebræ 40 (counted in one example only).

Body long and slender, slightly deeper and more compressed than in *A. ischanus*, which much resembles this species. Dorsal outline very little arched; ventral outline nearly straight from gill opening to insertion of anal fin, the lower profile of head oblique, nearly straight. Belly compressed, keeled for anterior two-thirds of its length in front of base of ventrals.

Head long and pointed, its width 1½ times in its length. Maxillary abruptly widened opposite the mandibular joint, tapering posteriorly to a blunt point, which reaches almost to the gill-opening, its length equal to length of base of anal. Snout long, sharp, and projecting, abruptly compressed in its terminal portion as seen from above, its length two-thirds diameter of orbit, or slightly more. Branchiostegal membranes united at base for a very short distance. In four examples examined as to this point, the gill rakers are as follows: 20+25, 23+24, 21+23, 19+30; the longest contained $1\frac{1}{2}$ to $1\frac{2}{3}$ in eye. Scales large, thin, deciduous, a few only remaining on the specimens at hand. Origin of the dorsal fin equally distant from the base of the caudal fin and the tip of snout or front of eye. Anal inserted under beginning of posterior third of base of dorsal. Pectorals not reaching ventrals, the latter extending three fifths distance to front of anal.

Color light olive, with broad, well defined, lateral silvery streak of nearly uniform width, usually narrowing anteriorly and on middle of caudal peduncle, its width in our largest specimens five-sixths diameter of eye. The silvery streak has a slight golden tinge. A narrow dark vertebral line, which widens on the nape. Occiput blackish.

This species differs from *A. cultrata* in its slenderer body, shorter snout, wider opercle and smaller teeth; the belly is also not sharply carinate, the dorsal is more anteriorly placed, the ventrals are farther back, and the silvery streak is wider anteriorly. It differs from *A. delicatissima* in its longer, slenderer head and body, smaller eye, longer, sharper snout, and much wider, better defined silvery streak.

Length 4 to 6 cm. Named for Mr. Edwin Chapin Starks.

85. Anchovia panamensis (*Steindachner*).

This species was found to be rather common.

Dr. Steindachner seems to have had both *A. panamensis* and *A. mundeola*, as his description covers both in many respects. His count of scales would apply better to *A. mundeola* than to *A. panamensis*, which has 38 to 41. The length of head, $4\frac{2}{5}$, applies better to *A. panamensis*, that of *A. mundeola* being generally about 4 in length of body. Otherwise there seem to be no differences.

86. Anchovia mundeola (*Gilbert & Pierson*).

Stolephorus mundeolus Gilbert & Pierson (Jordan & Evermann, 1898, p. 2812).

Head 4.15 (4 to 4.25); depth 3.77 (3.40 to 4.25); eye 3.44 in head (3.12 to 3.70). Dorsal 13 or 14; anal 33 (33 to 35); scales 36 (36 to 39). Dorsal and ventral contours about equally and gradually rounded from the middle region of body to the tip of snout and base of caudal fin. Snout short, high, compressed, blunt at tip, its length $1\frac{4}{5}$ in eye. Eye very large. Maxillary broad, tapering to a sharp point which reaches margin of gill-opening. Gill-rakers 17+21 to 22+24; the longest $1\frac{1}{2}$ to 2 in eye. Anterior insertion of dorsal fin varying from a point midway between base of caudal and middle of eye to a point midway between the caudal and tip of snout. In ten examples its insertion is before that of the anal. Anal fin long, averaging 33 rays; its origin beneath the anterior third of the dorsal; length of base shorter than in *A. panamensis*, being $3\frac{1}{25}$ in length, while in the latter its length is contained $2\frac{1}{2}$ in length. Pectorals long, reaching well beyond the insertion of the ventrals, equaling length of head behind front of pupil; a large axillary scale. Ventrals scarcely reaching vent.

Color uniformly light olive with silvery reflections; a faint, narrow, silvery stripe, sometimes scarcely distinguishable. Sides of head plain silvery. Upper margin of orbital rim black. Dorsal region blackish. A faint, narrow, dark line on each side of the light mid-dorsal streak. Caudal slightly dusky. Fins otherwise unmarked.

This species is closely allied to *A. panamensis* and *A. compressa*, but may be distinguished from the former by its longer head, larger eye, greater depth, fewer scales along the lateral line, and its much shorter anal base; also by the much fainter lateral silvery stripe. The eye is contained 14 to 16 times in length, excluding the caudal; while in *panamensis* the length contains the eye 16 to 20 times.

From *A. compressa* it differs in the relative length of the head and maxillary. In *A. mundeola* the maxillary is contained in the head 1¼ times (1.19 to 1.37); in *compressa* 1½ times (1.30 to 1.81). In *mundeola* the head is contained 4.15 times in the length; in *compressa* 4.44 times.

Since the publication of the above description, as cited, the material has been further studied by Chloe Lesley Starks, whose results we are permitted to incorporate below.

Twenty-seven specimens were measured, ranging in size from 72 to 120 mm. in length. In *A. panamensis* the head measures .21 to .25 of the length exclusive of the caudal; in *A. mundeola* .24 to .26. The depth of *panamensis* is .24 to .26; of *mundeola* .24 to .27. The size of the eye is the most striking difference between the two species, holding well from .05¾ to .06¾ in *panamensis* and from .07 to .07⅓ in *mundeola*. The maxillary measures about the same throughout (doubtless some tips are broken). In *panamensis* the snout measures about .04 and in *mundeola* from .04 to .05. Gill-rakers and also the rays in the dorsal and anal fins number about the same in the two species. The length of anal base in *panamensis* seems generally longer, running from .35 to .39 of length, while in *mundeola* it runs from .33 to .36. The number of scales varies from 39 to 41 in *panamensis*; from 36 to 39 in *mundeola*.

The extremes of the two species differ greatly in appearance, and no difficulty is encountered in separating them; but a few specimens seem to come so nearly intermediate that it is difficult to know to which form to assign them. When collected the two species were easily separable on account of the faint, silvery, lateral stripe of *mundeola*, but since preservation it has so faded in both species that it cannot be considered.

These two species may prove to be the same, but since *A. mundeola* has been described, it will be better to consider the two as distinct, until enough material can be obtained to settle the point beyond question.

Measurements in Hundredths of Length to Base of Caudal.

Length without caudal, in mm.	Head.	Depth.	Eye.	Maxillary.	Snout.	Base of anal.	Number of gill-rakers.	Number of anal rays.	Number of dorsal rays.	Number of scales.
ANCHOVIA PANAMENSIS.										
77	24	25⅓	6	18	4	36	16 + 22	34	13	40
89	23	25	6⅓	18⅓	4	38	16 + 22	32	13	40
92	22	26	6⅔	19	4	36	15 + 18	32	12	41
86	21	24	5¾	17⅓	4	38	16 + 22	32	13	39
71	23	24	6	18	4	37	16 + 22	33	13	41
88	23	25	6	17⅓	4	38	16 + 24	35	14	39
89	23	24	6⅔	17	4	39	17 + 22	33	13	40
109	24	26	6⅔	19	4	35	16 + 25	30	14	40
105	24	26	6⅔	18⅔	4	36	18 + 22	32	13	39
79	25	26	6¾	20	4	35	15 + 19	32	14	40

Measurements in Hundredths of Length to Base of Caudal.

Length without caudal, in mm	Head	Depth.	Eye	Maxillary.	Snout.	Base of anal.	Number of gill-rakers	Number of anal rays.	Number of dorsal rays.	Number of scales
ANCHOVIA MUNDEOLA.										
84	25	25⅓	7⅓	19	5	36	16 + 23	30	13	39
83	25⅓	24⅓	7	19½	4⅓	35	16 + 22	33	13	38
91	25⅓	25	7	19	4½	36	16 + 19	31	13	37
87	25	26⅓	7	21	5	34	16 + 19	31	13	39
78	25	24	7	20	4½	35	17 + 22	32	13	38
104	26	25⅓	7	19	4⅓	35	17 + 23	33	13	37
108	24	27	7	18	4	36	20 + 24	35	14	37
102	24½	27	7	18⅓	4	36	16 + 25	33	12	37
93½	25	26	7	20⅓	4½	34	17 + 23	32	13	39
101	24½	26	7⅓	19	4½	34	17 + 22	33	12	37
82	26	26	7	21	5	33½	16 + 17	31	13	37
116	25	28	7	20	5	34	17 + 22	31	13	39
120	24	27	7	19	4	34	16 + 23	32	14	37
108	24⅓	27	7	20	4¾	35½	18 + 22	31	14	36
75	25	26	7⅓	20	4⅓	35	17 + 23	31	13	38
103	25	26⅓	7⅓	21	4	33	17 + 24	30	12	37
107	25	26	7⅓	20⅓	4	35⅓	20 + 23	31	14	36

87. **Anchovia spinifera** (*Cuvier & Valenciennes*).

PLATE VIII, FIG. 15.

Two specimens were taken in shallow water by means of a cast-net.

Head 4 in length; depth 4; dorsal 16; anal 38; scales 42. Form moderately slender, the dorsal outline ascending in nearly a straight line from snout to front of dorsal, where it reaches the greatest height; thence descending at about the same angle in a straight line to caudal peduncle; ventral outline evenly curved from tip of lower jaw to caudal peduncle. Abdomen somewhat compressed, not serrated.

The head is rather long, and has a sharp conical snout. The upper posterior outline of the gill-opening is very oblique. A line drawn from snout to angle of opercle would nearly parallel the oblique maxillary. The subopercle projects beyond the opercle in a triangular process. The eye is placed within the first two-fifths of the head. The maxillary is slender, and not angulated on its upper outline towards its posterior end. It is widest near angle of mouth, and ends in a rather sharp point near lower edge of gill-opening. The teeth are small but sharp. The gill-rakers are slightly shorter than the orbit; about 15+17 in number.

The origin of the anal is about under the middle of dorsal. The pectorals extend to or slightly past the middle of the outer ventral rays.

Owing to the action of formalin, these specimens have little of their original color left. Where scales remain, the lower parts of the sides are bright silvery, rather abruptly shaded to olive above. Apparently no lateral stripe was present. The caudal and the first rays of dorsal are tipped with black. In life, the caudal and dorsal were otherwise bright yellow.

Measurements in Hundredths of Length to Base of Caudal.

Length without caudal, in mm.	Head.	Depth.	Eye.	Maxillary.	Snout.	Length of anal base	Longest dorsal ray.	Longest anal ray.	Longest pectoral ray.
96	26	25	5½	22	4	38	20	15	17½
99	26	26	5½	22	4½	39	19	14	17

88. **Anchovia macrolepidota** (*Kner & Steindachner*).

Very abundant, reaching a large size and used for bait. The body is closely compressed, and very minute teeth persist in the maxillaries even in adults.

89. **Cetengraulis mysticetus** *Günther*.

Abundant; often used as bait in hand-line fishing. It reaches a length of 20 cm. Our specimens have been compared with *C. edentulus* from Jamaica, and are found to differ from this closely related Atlantic representative in the slightly longer head, slenderer body and caudal peduncle, smaller eye, and shorter anal fin. The anal has an average of but one less ray, instead of three less, as given by Jordan & Evermann, 1896, p. 450.

In the original description, the gill-rakers on the lower part of arch are said to number 42. Dr. Boulenger has kindly reëxamined for us the three types in the British Museum, and finds in each from 55 to 60 gill-rakers. The number in the specimens at hand ranges from 53 to 66. In these specimens, the pectorals usually do not reach the ventrals, either terminating some distance from them, or rarely approximating them.

The color in life is light olivaceous or olive-green above, passing into the bright silvery of sides and lower parts. No lateral stripe. Caudal margined with dusky.

Measurements in Hundredths of Length without Caudal.

Species	CETENGRAULIS MYSTICETUS					CETENGRAULIS EDENTULUS				
Locality	*Panama*					*South Atlantic*				
Length without caudal, in mm	149	153	144	145	152	106	96	101	109	104
Head	36	36	37	37	35½	34	33	33	33	33
Depth	31	30	31	29	30½	31½	33	33	34½	32
Orbit	8	7½	7½	8	7½	8	9	8	8½	9
Maxillary	21	21½	22	21½	21	20	20	19	20	20
Snout	4	4	4	4½	4	5	5	5	5	5
Greatest length from preopercular ridge to gill-opening	14	15	15	14	15	12	12	12	11	12
Number of dorsal rays	15	15	15	15	14	14	14	15	15	15
Number of anal rays	22	23	23	22	22	24	24	23	23	23
Number of scales	42	40	43	43	42	39	40	41	40	41

90. Cetengraulis engymen *Gilbert & Pierson.*

Cetengraulis engymen GILBERT & PIERSON (Jordan and Evermann, 1898, p. 2815).

This species differs from *C. mysticetus* in the much narrower union of the gill membranes, the less numerous gill-rakers, and in the longer snout. Head 3 to 3.3 in length; depth 4 to 4.9; eye 4 in head; dorsal 14 or 15; anal 20 to 23; vertebræ 41. Body compressed, fusiform, not so deep as in *mysticetus* or *edentulus*. The dorsal and ventral outlines are about equally and regularly curved in the larger specimens; in the smaller specimens the ventral contour is more nearly straight. Belly trenchant, but not carinate nor serrate; caudal peduncle moderate, its depth being contained 1.5 times in its length. Head similar to *mysticetus;* the snout longer, contained 5.5 to 7 times in head, 1½ times in eye (the snout is contained 8 to 9 times in head, in *mysticetus*). Both jaws bear minute teeth, those on the maxillary largest. Branchiostegal membranes united for only ⅔ to ¾ of the distance between tip of mandible and mandibular articulation; wholly free from the isthmus. Tip of mandible directly beneath the anterior border of orbit. Gill-rakers long, nine-tenths diameter of eye, 20 to 30 on the upper limb, 25 to 30 on the lower limb; in five examples as follows, 25+30, 27+25, 30+26, 25+30, 23+29 to 20+25.

The origin of the dorsal is midway between base of median caudal rays and a point varying between front and middle of the eye. Insertion of anal below the posterior fourth or third of the dorsal, its length equaling the distance from the posterior border of the eye to insertion of pectoral. The pectoral is short, 2¼ to 2⅓ in head, failing to reach the insertion of the ventrals by half or nearly half its length. Caudal deeply forked, its median rays 2½ to 3 times in head.

Color uniformly silvery, with a distinct, well defined lateral silvery band, extending from upper angle of gill-opening to base of caudal; its greatest width equals the diameter of orbit, becoming narrower on caudal peduncle.

Length 38 to 57 mm.

91. **Lycengraulis poeyi** (*Kner & Steindachner*).

Seven specimens were taken, the largest 198 mm. in total length.

In some of the specimens the pectorals scarcely reach to the base of the ventrals, while in others they reach a very little past this point. The gill-rakers become shorter and somewhat thicker with age.

We have compared these specimens with a single specimen of *L. grossidens* from Pernambuco, Brazil. The latter specimen seems to differ from *L. poeyi* in having a slightly longer maxillary, a greater distance separating the tip of snout from lower angle of cheek, and in the slightly larger teeth, which are more uneven and more widely spaced.

Measurements in Hundredths of Length without Caudal.

Species	LYCENGRAULIS POEYI.					L. GROSSIDENS.
Locality	*Panama.*					*Brazil.*
Length without caudal, in mm.	186	159	153	189	198	169
Head in 100ths of length	23½	23	23½	23	23½	24
Depth	26	24	24	25	24	25
Eye	5	5	5	5	4¾	4¾
Maxillary	18	17½	18½	18	18	20½
Origin of dorsal from snout	56½	56	54½	55	54½	55½
Greatest distance from eye to gill-opening	15	14	14⅓	14½	14	15½
Snout to lower angle of cheek	18½	18½	18	18	19	20½
Dorsal rays	15	14	15	14	14	15
Anal rays	24	25	24	24	25	24
Gill-rakers	14+20	15+19	14+20	14+20	12+19	14+18
Scales	40	40	41	41	40	39

Family SYNODONTIDÆ.

92. **Synodus evermanni** *Jordan & Bollman.*

Dredged by the "Albatross" in Panama Bay, at Stations 2795 and 2797, 33 fathoms; not seen by us. The species is also known from "Albatross" Stations 2831, 3043, 3044, off the coast of Lower California, in depths of 12 to 74 fathoms; and Station 2998, Gulf of California, 40 fathoms.

93. Synodus scituliceps *Jordan & Gilbert.*

Synodus jenkinsi JORDAN & BOLLMAN, 1889, p. 153.

Two specimens seen, one of which is 40 cm. long, and is preserved. The head is remarkably long, $3\frac{2}{3}$ in length. Five rows of scales between lateral line and median series before dorsal; seven rows between lateral line and median series before anus; sixty scales in lateral line; six rows on cheeks. These characters would range the specimen under the nominal species *S. jenkinsi*, which we are unable, however, to distinguish from *S. scituliceps*. Specimens from Mazatlan with short head (typical *S. scituliceps*) have five or six rows of scales on the cheeks (never four as originally described), and have the anterior dorsal rays reaching or not reaching tip of posterior ray when depressed. In these, the head varies from $3\frac{3}{4}$ to $4\frac{1}{3}$ in length, no specimen before us having the head as small as described for the type of *S. scituliceps* ($4\frac{3}{8}$).

The species was also seen at Acapulco (Dec. 20), several specimens being observed lying on the sandy bottom near the wharf. They lie rigidly in a straight line, and their colors harmonize so well with that of the sand that they are detected with difficulty. One specimen, on coming to rest after swimming a short distance, disappeared in the sand, leaving only the tip of the snout exposed. It did not enter head first, but settled into the sand with its whole length at once, apparently throwing up the sand by motions of its pectoral and ventral fins.

Family PŒCILIIDÆ.

94. Pœcilia elongata *Günther.*

Very abundant in the brackish sloughs about Panama. We found it also in the market, where numerous specimens were taken from 5 to 18 cm. in length. These are all females, no males being seen. All of the specimens examined have young in the oviduct, about 18 mm. in length, apparently about ready to be set free. They have four or five narrow, distinct cross-bars on the body. The scale-pouches have also a narrow, dark border, which shows through the scales as in the adult.

We here supplement the original description, from specimens 10 to 18 cm. in length. Head $3\frac{3}{5}$ to $4\frac{2}{5}$ in length; depth $3\frac{1}{2}$ to 4. Eye $3\frac{1}{2}$ to $4\frac{1}{5}$ in head, slightly less than half the interorbital width in the larger specimens, slightly more than half in specimens 10 cm. long. Interorbital width half head. Height of caudal peduncle $1\frac{1}{4}$ to $1\frac{2}{5}$ in head, diminishing in height but slightly (sometimes not at all) from dorsal to caudal base. Scales in six specimens 30, in six specimens 31, in four specimens 32. Nine specimens have 10 dorsal rays, two have 9; eight specimens have 9 anal rays, four have 8.

After removing and drying the jaws, a narrow band of very fine villiform teeth, behind the dark-tipped slender outer teeth of each jaw, may be seen by the aid of a lens.

95. Pœcilia boucardii *Steindachner.*

Very abundant in fresh and brackish water. Found in every pond and stream in the savannah about Panama. They agree very well with Dr. Steindachner's description of the typical specimens, which were taken about Colon.

The black spots on the caudal are quite variable in size. In most specimens the caudal fin and even the posterior part of the caudal peduncle, is profusely covered with rather large black spots. There are elongate or elliptical spots between the rays, and smaller indistinct spots are on the rays. In a few specimens the spots are small and diffused, those on the rays being most persistent. The young, 25 to 40 mm. long, have only small indistinct spots.

96. Anableps dowei *Gill.*

Not seen by us.

The types of the species have been ascribed to Panama, this locality being based on the following ambiguous statement by Gill (1861 *a*, p. 3): "There has recently been sent to the Smithsonian Institution from Panama, by Captain J. M. Dow, a new species of the genus *Anableps.*" While this specimen was *sent* from Panama, it was apparently not captured at that point, as witness the following statement published by Dow (1861, p. 30): "Some time since, while in the bay of La Union, State of San Salvador, I caught . . . a couple of what I supposed was *Anableps tetrophthalmus;* but upon sending them to my friend, Professor Baird, of the Smithsonian Institution at Washington, was somewhat surprised and gratified to hear that they were of an entirely new species . . . *A. dowii.*" On a subsequent trip, Dow obtained (l. c.) from the same locality several specimens, which were likewise sent to the Smithsonian Institution (see Jordan and Gilbert, 1882 *i*, p. 373). Others are recorded by Günther (1866 *a*, p. 338) from Chiapam and Guatemala, and still others (Günther, 1864 *b*, p. 27) are said to have been collected by Captain Dow on the "Pacific Coast of Panama."

There seems to be no warrant for changing the spelling of the specific name, as has been done, to *dowi, dowii* or *dovii.* It appears as *dowei* in three places in the original description, a fact which sufficiently indicates the deliberate intention of the author concerning it.

Family ESOCIDÆ.

97. Tylosurus scapularis *Jordan & Gilbert.*

Several specimens seined in fresh water at Miraflores. Four specimens preserved, the largest 41 cm. in length, the others 23.

In these specimens the caudal peduncle is not compressed, as described for the type, but is about as wide as deep. The body is somewhat depressed, especially in the ventral region. The description of the type states that the eye "is contained 8 or 9 times in the length of the upper jaw" (this agrees with our specimens), "and

3½ times in rest of head." This last doubtless should read postorbital part of head. The eye in our specimen is contained 4½ to nearly 5 times in head without upper jaw. The description states that the anterior dorsal rays are "as long as from eye to edge of opercle." This should read to edge of preopercle or to anterior edge of opercle.

The lateral band tapers to a point at each end. It is nearly confined to the posterior third of the body, and does not reach to the caudal rays. In the large specimen it is dusky silvery and has ill-defined edges, while in the small ones it is well defined and bright silvery. It is bordered above with a dark streak, very conspicuous in the younger specimens, but diffused and only slightly darker than the body in the large specimen.

98. **Tylosurus stolzmanni** (*Steindachner*).

Two specimens were taken, 51 and 62 cm. in entire length. Besides these we have in the Museum of Stanford University a specimen from Mazatlan of about the size of our smaller specimen. These are larger than the type (477 mm. in length), from the description of which they differ in some minor respects.

In our specimens the body is as broad as high at the region of the ventrals. The interorbital space is a little wider than diameter of eye, which is contained 12 times in length of head. The anal base is a little longer than the dorsal base. The insertion of the ventrals is nearer the caudal base than the posterior border of the eye by from 1 (in the larger specimen) to 3 times the diameter of the eye.

This is probably the species recorded by Boulenger (1899, p. 2) from the Gulf of Panama, under the name *Belone truncata*.

99. **Tylosurus fodiator** *Jordan & Gilbert*.

Not uncommon at Panama. Like other gars, it is called Aguja by the native fishermen.

100. **Tylosurus pacificus** (*Steindachner*).

Three specimens were collected, which agree very well with the description of the type.

Family HEMIRHAMPHIDÆ.

101. **Hyporhamphus unifasciatus** (*Ranzani*).

Two specimens collected at Panama by Captain J. M. Dow have been identified by Jordan and Gilbert (1882*i*, p. 373) with the short-nosed half-beak, *H. poeyi* (= *H. unifasciatus*). The species is also recorded from Panama by Jordan & Bollman (1889, p. 180).

102. Hyporhamphus roberti (*Cuvier & Valenciennes*).

One small specimen taken, about 15 cm. in length.

103. Hemirhamphus saltator sp. nov.

PLATE IX, FIG. 16.

Hemirhamphus balao JORDAN, 1885, p. 370 (Panama); not of Le Sueur.

Head from tip of upper jaw, $4\frac{1}{3}$ in length from the same point to base of caudal, depth $6\frac{1}{4}$ to $6\frac{9}{10}$. Dorsal 13 or 14; anal 11 or 12; scales 53 or 54.

Body compressed, the sides vertical and parallel. Mandible from tip of upper jaw $4\frac{1}{4}$ to $4\frac{1}{2}$ in length. Diameter of eye slightly exceeding interorbital width, 4 to $4\frac{1}{2}$ in head. Pectoral $1\frac{1}{5}$ to $1\frac{1}{4}$ in head. Insertion of ventrals midway between base of caudal and anterior third of pectoral fin. Last ventral ray produced, and longer than first ray. Front of anal a little anterior to middle of dorsal base; the posterior end of anal base coterminous with that of dorsal. Posterior ray of dorsal produced; anterior rays about a third higher than those of anal.

Color uniform bright silvery on lower part of sides, dusky silvery above. An inconspicuous, dark, narrow lateral streak extends from upper angle of gill-opening to just above middle of caudal. Top of head and upper jaw dark. Dorsal and caudal dark; pectorals dusky; ventrals colorless, except a slight dusky tinge towards ends of outer rays; anal white.

This species is closely related to *H. brasiliensis* from the West Indies, with which it has been identified. It differs from that species in the smaller eye, longer mandible, and longer pectoral fin. The insertion of the ventrals is more anterior; the horizontal length of the opercle is greater; the anterior rays of the dorsal are lower, and there are one or two more scales in a horizontal series.

Eight specimens were taken, from 41 to 46 cm. in entire length.

Measurements in Hundredths of Length without Caudal

Species	HEMIRHAMPHUS SALTATOR								HEMIRHAMPHUS BRASILIENSIS										
Locality	Panama								Jamaica									Havana	
Length from tip of upper jaw to base of caudal, in mm	266	242	256	277	251	213	252	283	211	209	210	215	190	207	198	191	192	173	222
Head from tip of upper jaw in 100ths of length	24	23½	23½	23½	24	23½	24	23	23½	24	24	23	24½	24	24	24½	23½	24½	24
Depth	14½	16	16½	15½	15½	15½	15½	16	18	17	17½	16	18	17	17	17½	16½	17	16
Eye	5½	5¾	5½	5¾	5¾	5½	6	5½	6	6	6	5½	6	6¾	6	6½	6	6½	6½
Mandible from tip of upper jaw	30	brok'n	30½	broken		30½	32½	25	26	24	26	26½	30	25½	brok'n	27½	27½	broken	
Insertion of ventrals from caudal base	36	36	36	35½	35½	35½	35½	36	33½	35	34½	35	33	34½	34	33½	34½	33	33
Length of anal base	8½	8	9	8	8½	8	9	8	8	8½	8	8½	8	8	8	8½	8½	8	8½
Length of opercle	7	6½	7	7	7	7	7	7	6½	6	6½	6½	6½	6¾	5½	6¾	6½	6½	6½
Length of pectoral	18	19	20	20	20	21	20½	20	17½	17	16½	16	17¾	17	17	17½	16½	17½	16½
Length of highest dorsal rays	9	8½	9	9	8½	9	9	9	10½	10	brok'n	10	10	9½	9½	10	9½	broken	
Number of dorsal rays	14	13	14	13	13	13	14	14	14	13	13	15	13	13	14	13	15		
Number of anal rays	11	11	12	11	12	11	12	12	12	12	12	12	12	12	12	12	13		
Scales	54	54	54	53	53	54	54	54	52	52	52	51	51	53	51	52	52		

Family EXOCŒTIDÆ.

104. **Fodiator acutus** (*Cuvier & Valenciennes*).

Abundant in Panama Bay; many were seen flying, and four specimens were taken, 145 to 158 mm. in length. They agree well with the description of the type.

105. **Cypselurus callopterus** (*Günther*).

Two specimens were collected, 25 and 31 cm. in length. They agree well with Dr. Günther's description and plate.

106. **Exonautes rufipinnis** (*Cuvier & Valenciennes*).

Only the type of *Exocœtus dowi* Gill, 1863, p. 167, (= *E. rufipinnis*), is known from the vicinity of Panama.

Family FISTULARIIDÆ.

107. **Fistularia depressa** *Günther*.

A single large specimen was taken in the market at Panama.

We have examined specimens from Japan, Honolulu, the Philippines, and La Paz, L. C., and can distinguish no differences between them. In the figure of this species given by Dr. Günther (Shore-fishes, Challenger, Plate XXXII), the greatest width between the diverging ridges on the anterior part of the snout is indicated at a point too far forward. In our specimens the ridges are farthest apart at the beginning of the anterior $\frac{2}{7}$ or $\frac{1}{4}$ of the snout. The interorbital area appears to be more concave in small specimens (25 cm. in length) than in the larger ones. In the latter the interorbital is contained $5\frac{1}{2}$ in the postorbital part of the head. In specimens 50 cm. in length the orbit (measuring the extreme length between the bones surrounding the eye) is from $9\frac{1}{4}$ to $9\frac{3}{4}$ in the head, and the length of the maxillary is $9\frac{1}{2}$. In a specimen 69 cm. in length, the maxillary is contained 10 times and the eye 11 times in the head.

A large number of small specimens 25 to 28 cm., and one specimen 41 cm. in length from Honolulu, are plain brown on the back, while a larger specimen 61 cm. long has blue spots, as in our Panama specimen. Four specimens from La Paz, 51 cm. long, all show blue spots. The following color description was taken from our Panama specimen in the fresh condition.

Olive-brown on upper parts, white below. A pair of narrow blue stripes, interrupted anteriorly and posteriorly, begin at the nape, diverge backward and cross the lateral line just in front of the point where it becomes straight, then run just above and parallel to the lateral line as far as the tail. Another pair of streaks, made each by a series of blue spots, runs close along each side of mid-dorsal line, from a point above axil of pectorals to front of dorsal. Behind dorsal a single series of spots occupies the median line of back.

108. **Fistularia corneta** sp. nov.

PLATE X, FIGS. 18 AND 18*a*.

Five specimens, each 62 cm. long, were seen in the Panama market; two of these were preserved. Besides these, we have in the collection of Stanford University several small specimens from Panama, collected by the "Albatross," and several small ones from Mazatlan.

Head 3 in length. Depth of body, a short distance in front of dorsal fin, $\frac{4}{5}$ the depth at occiput. At insertion of ventral fins the width of the body is twice its depth. The extreme length of the orbit is contained 9 times in the length of the head; maxillary $13\frac{2}{5}$ to $13\frac{3}{5}$; interorbital width (bone) $3\frac{3}{4}$ to 4 in postorbital part of head. Length of pectoral, from base of upper ray to tips of longest rays, $6\frac{3}{5}$ to 7 in head; ventrals 11.

The maxillary is rather short, and has a concave posterior border. The upper lateral ridge of snout is serrated on its posterior three-fifths. On the anterior half of the serrated portion, the serrations become abruptly finer and more crowded. The two superior ridges of the snout are rather wide apart posteriorly, and very gradually approach each other anteriorly. They are scarcely divergent or even parallel in the large specimens, but in the small ones they diverge slightly on the anterior half of the snout. The distance between them is everywhere much greater than their distance from the upper lateral ridge. The area between the upper lateral ridge and the superior ridges is generally smooth, sometimes somewhat uneven, but never roughly sculptured. The interorbital area is flat and roughly sculptured on each side, and its middle third is depressed to form a smooth channel.

The pectoral reaches about one-third of the distance between the base of its upper ray and the insertion of the ventrals. The dorsal and anal fins are exactly opposite and equal in length; their base 4 times their distance from the middle caudal rays. The skin is everywhere smooth; the lateral line is not armed with bony plates.

In the five specimens seen at Panama (fresh) the back was a uniform dark brown. In the small specimens from Panama and Mazatlan there is usually a lighter stripe, with ill-defined edges, on each side of the back, a short distance above the lateral line, and following its course to the base of the caudal fin.

This species differs from *F. depressa* in having a shorter maxillary, a larger eye (in specimens of the same size), and particularly in having a much wider interorbital space. There is no trace of blue markings in our material.

We have several specimens of *F. petimba* from Formosa and Japan, which agree well with the description given by Dr. Günther (Shore-fishes, Challenger, p. 68) under the name *F. serrata*. They differ from *F. corneta* in having the superior ridges of the snout very close together and parallel for nearly their whole length. (They are spoken of as *ridges*, though they appear, in this species especially, as a single, raised, flat area posteriorly, the sides of which are left in relief as ridges anteriorly.) The distance between them is everywhere much less than their distance from the upper lateral ridge. The area between the upper lateral ridge and the superior ridges is roughly sculptured with radiating lines, as shown in the illustration accompanying the description cited above (Plate XXXII). The interorbital area is deeply concave and without flat supraorbital areas. The serrations of the upper lateral ridge are coarse. The skin is rough to the touch, and the lateral line is armed with small, bony, stellate plates, which become larger posteriorly.

We have no specimens of *F. tabacaria*, but from current descriptions it is different from *F. cornuta*. It seems always to have blue spots and to have few or no serrations on the upper lateral ridge. It has not been recorded from the Pacific.

Family SYNGNATHIDÆ.

109. **Siphostoma auliscus** *Swain.*

Two specimens, 122 and 88 mm. long, were taken in the Rio Grande, at Miraflores, near Panama. We have compared them with two small specimens of *S. auliscus* from Magdalena Bay, L. C., and find the only difference to be the more anterior anal opening in the smaller specimen, in which it occupies the ring just anterior to dorsal. In the other specimens it is in the same ring with the front of dorsal. The Panama specimens are darker and more mottled. Each body ring has a broken vertical white streak, and on about every fifth ring is a faint dark streak.

110. **Hippocampus ingens** *Girard.*

Three specimens taken, 5, 8, and 10 cm. long. The smaller two, a male and a female, are rough with papillæ, and have many dermal flaps. The largest one, a female, is almost perfectly destitute of these, though upon close examination with a lens very small, white papillæ are to be seen.

Two specimens from Mazatlan in the collection of the Stanford University have been examined. One is smooth, the other covered with dermal flaps.

Family ATHERINIDÆ.

111. **Kirtlandia pachylepis** *(Günther).*

This species and *K. gilberti*, referred to the genus *Menidia* by Jordan and Evermann (1896, pp. 798 and 801), the former afterwards transferred to the genus *Thyrina* by these authors (1898, p. 2840), belong to the genus *Kirtlandia*. We have compared them with *K. vagrans*, the type of the genus. Like the latter, they have crenate scales, which are, however, smooth, not "very rough to the touch," as described by Jordan and Evermann. Our specimens of *K. vagrans* and *K. pachylepis* have no scales on the dorsal. The base of the anal has a row of rather long scales. Both the dorsal and anal of *K. gilberti* are scaleless.

Nine specimens of *K. pachylepis* were collected. They differ from Günther's description only in the slightly longer head, and in a greater range of fin-rays.

Head and depth 5 in length of body without caudal. Eye and snout about equal, 3½ in head. Angle of lower jaw slightly in advance of front of orbit. Interorbital space one-fourth or one-fifth wider than eye. Jaws with a band of villiform teeth. Pectorals reaching nearly to tip of ventrals. Anal and soft dorsal conterminous. Scales 41 to 43. About 27 scales on back in a series between occiput and spinous dorsal. Fins unmarked. Snout and a small area on top of head behind eye dusky. Back dusky, with small brown punctulations, which narrowly border each scale. Lateral streak dark above, shading downward into silvery, widest under the dorsals. A dark line on back from dorsal to occiput, composed of a single row of dark brown dots; more conspicuous in the smaller specimens.

Measurements in Hundredths of Length without Caudal.

Length without caudal, in mm....	115	99	97	99	109	100	97	97	82
Head..................................	20½	20½	20	20	21	20½	20	20½	20
Depth..................................	20½	21	20	20½	20	20½	19½	20½	19½
Eye....................................	7	6	6⅓	6	6	6½	6	6½	6½
Snout..................................	6⅓	6	6	6	6	6	6	6	6
Insertion of ventrals from snout...	43	41	43	41	42	42	42	42½	40½
Length of anal base.................	24	24½	25½	25½	24	26½	23½	25½	25
Length of pectoral..................	28½	28	27	29	27½	28	27	27	26½
Number of dorsal rays.............	V-I,8	IV-I,7	V-I,8	IV-I,8	V-I,7	V-I,7	IV-I,7	V-I,7	V-I,7
Number of anal rays	I,21	I,22	I,21	I,21	I,23	I,23	I,21	I,21	I,21
Scales	42	43	43	42	44	42	43	41	42

112. **Kirtlandia gilberti** *(Jordan & Bollman).*

Of this species we obtained nine specimens, which we have examined in connection with thirteen co-types collected at Panama by the "Albatross."

Only two of these have six dorsal spines, as described for the type; fifteen of them have 5; and five of them have 4. The origin of the first dorsal in the type is described as being at a point midway between the posterior margin of the head and the base of the caudal. We find that it varies from this to a point half the diameter of the eye nearer to the occiput. The longest spine (probably owing to a slip of the pen) is alleged to be 4⅓ in the head. This should read 3⅓ to 3½. The longest ray of the soft dorsal exceeds the length of the snout by from one-fourth to one-half the diameter of the eye. The origin of the anal varies in position from a point midway between base of caudal and posterior base of pectoral (as described), to a point midway between base of caudal and middle of upper pectoral ray; the width at base is generally somewhat greater than "distance from tip of snout to base of pectorals." The scales are crenate, but smooth to the touch. The dorsal and anal are scaleless.

The edges of the lateral band are well defined, and a much darker streak composes its upper edge. It is widest under the dorsals, thence narrows on the caudal peduncle and widens at base of caudal fin. Its termination is rounded.

Measurements in Hundredths of Length without Caudal.

Length without caudal, in mm.	103	105	110	103	98	103	97	93	95
Head	22	21	22	20½	20½	21	21	21	20½
Depth	17	17	17	17	17½	17½	17½	16½	17
Eye	6	6	6	6	5½	6	6	6	6
Origin of anal from caudal base	36	37	37	38	40	38	38	38	38
Origin of first dorsal from caudal.	44	43	44	43	43	45	42½	43	43
Length of pectoral	19	18½	18	19	18	18	19	18	18½
Length of anal base	19	20½	20½	21	21	20	20	21	20
Number of dorsal spines	V	IV	V	V	IV	V	IV	V	V
Number of dorsal rays	I,9	I,8	I,9	I,9	I,8	I,9	I,9	I,9	I,9
Number of anal rays	I,19	I,19	I,19	I,21	I,20	I,20	I,20	I,19	I,20
Number of scales	51	49	49	50	50	50	49	50	51

Fin Formulæ of the Co-Types.

Dorsal	VI–I,9	V–I,9	IV–I,9	VI–I,9	V–I,9	V–(broken)
Anal	I,22	I,20	I,20	I,22	I,22	(broken)

Dorsal	V–(broken)	V–I,8	IV I,9	V–I,9	V–I,9	V–I,9	V–I,9
Anal	I,20	I,20	I,20	I,21	I,20	I,20	I,19

113. **Atherinella panamensis** *Steindachner.*

PLATE IX, FIG. 17.

A single specimen obtained, 13 cm. in entire length.

We add the following details to Dr Steindachner's excellent description:—Head 4⅕ in length; depth 4½. Eye 3⅔ in head; snout 3⅔; interorbital width 2¾. The enlarged outer teeth of the upper jaw are in two series only in front of jaw, in one series laterally. Pectoral 2¾ in length. The insertion of the ventrals is nearer the tip of the lower jaw than the base of the caudal by half the length of the head.

Family MUGILIDÆ.

114. **Mugil cephalus** *Linnæus.*

Taken by Gilbert at Panama in 1883 (Jordan, 1885, p. 371); not recorded by other observers.

115. **Mugil thoburni** *Jordan & Starks.*

Recorded (as *Mugil incilis*) from Panama (Jordan & Gilbert, 1882 *n*, p. 624) and from Chiapam (Steindachner). The types of the species were collected by the "Albatross" at the Galapagos Islands.

116. Mugil curema *Cuvier & Valenciennes.*

This species comes into the Panama markets in abundance. We have compared six specimens with others from the Atlantic and can distinguish no differences between them.

Measurements in Hundredths of Length without Caudal.

Locality	*Panama.*						*Jamaica.*		*Key West.*		
Length without caudal, expressed in mm.	205	212	240	250	192	190	201	231	145	118	230
Head	27	26	26½	26	26	26	26	26½	26	27	24
Depth	25	24	26	22	25	25	26	26	27	27	26
Interorbital (bone only)	9	9½	10	9	9	9½	10	10	9⅓	9	9
Insertion of ventral spine from snout	40	38	40	39	40	40	40	39½	39½	39	38
Front of spinous dorsal from snout	49½	49½	52	48½	50½	51	49½	52	50½	51	50
Tip of pectoral from snout	46½	44	45	44½	45½	47	45½	45	45½	47½	43½
Length of pectoral	19½	18½	18½	18½	18½	20	19	18½	19½	21	19
Length of anterior dorsal rays	11½	10½	11½	11½	12½	12	12	12	12½	13½	11
Length of anterior anal rays	12½	12	12	12	12	12½	12¼	12	13	14	12
Number of dorsal spines and rays	IV–I, 8	IV–I, 7	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8
Number of anal spines and rays	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9
Scales from above upper pectoral ray	38	37	37	38	37	37	37	36	36	37	37

117. Mugil hospes *Jordan & Culver.*

Abundant at Panama. It is at once separated from *M. curema* by the longer pectoral. We found the small crustacean nearly always present in the mouth of the Panama specimens, as it was in the type and co-types from Mazatlan.

Measurements in Hundredths of Length without Caudal.

Locality	Panama.								*Mazatlan* (Type)
Length without caudal, in mm.	212	193	212	222	230	190	217	219	170
Head (without opercular flap)	28	28	26½	27	27	27	26½	27	28
Depth	26	27	23½	24½	22½	24	21½	23	23
Interorbital (bone)	11	10½	10½	10	10	10½	10	10	10
Insertion of ventral spine from snout	41	42	39½	41	39½	40½	41	40½	39½
Front of spinous dorsal from snout	51½	53½	51	51½	51½	52	51	51	50
Tip of pectoral from snout	52½	53½	51	51½	51½	52½	52½	52½	50½
Length of pectoral	23½	25½	23	24	24	25	24	23½	23
Length of anterior dorsal rays	12	13	12½	12½	12½	12½	12½	12	12½
Length of anterior anal rays	12½	13	12½	13	12½	13	13	13	13½
Number of dorsal rays and spines	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8
Number of anal rays and spines	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9	III, 9
Scales	37	37	38	36	37	38	36	36	38

118. Chænomugil proboscideus (*Günther*).

Probably not so common as farther north. Two large specimens and several small ones were collected, the latter found in rock-pools, in company with *Querimana harengus*.

Measurements in Hundredths of Length without Caudal.

Length in mm.	191	154	76	56	48
Head	26	27½	28	29	30
Depth	29	31	34	32	31
Eye	6	6½	7½	8	8
Insertion of first spine of spinous dorsal from snout	56	56	56	57	55
Insertion of first spine of soft dorsal from snout	78	78	78	77	78
Insertion of anal spine from snout	75	75	70	73	72
Length of pectoral	23	23	25	25	26
Length of ventral	15	16	18	18	18
Number of dorsal rays and spines	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8
Number of anal rays and spines	III, 10	III, 10	III, 10	III, 10	III, 10
Scales	39	41	40	40	40

119. Querimana harengus (*Günther*).

This little mullet was taken in abundance in the rock-pools. There is considerable variation among the specimens, as the table of measurements will show. Nothing can be found, however, that would indicate more than one species among them. Out of fifty specimens examined, four were found with three anal spines. In each of these cases, a spine had replaced a ray, as only nine rays were present instead of the ten always found in two-spined examples.

Measurements in Hundredths of Length without Caudal.

Length in mm., without caudal...	47	40	45	43	45	45	41	44	41
Head	30	32½	32	31	31	29	28	32	28
Depth..................................	28	30	29	30	29	26	26	27	26
Eye....................................	7	8	8	7	7½	8	7½	8	8
First dorsal from snout............	53	55	55	53	53	51	51	53	51
Second dorsal from snout.........	75	76	75	76	76	74	72	74	72
Insertion of ventral spine from snout..............................	44	46	44	44	44	41	42	46	42
Anal from snout.....................	70	73	73	71	71	68	70	71	69
Length of pectoral..................	21	21	21	20½	20½	20	19	19	19
Length of anal base................	16	14½	15	15	16	15	16	15	15
Spines and rays of dorsals	IV–I, 8	IV–I, 9	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8	IV–I, 8
Spines and rays of anal............	II, 10	II, 10	II, 10	II, 9	II, 9	II, 10	II, 10	II, 10	II, 10
Scales	36	36	38	37	36	38	38	37	37

Family SPHYRÆNIDÆ.

120. Sphyræna ensis *Jordan & Gilbert.*

Not uncommon in the market at Panama, where nine specimens were collected. These agree very well with the description given by Dr. Steindachner (1879*b*, p. 4) under the name *S. forsteri*, he having confused it with that East Indian species.

Measurements in Hundredths of Length without Caudal.

Length in mm., from tip of snout to base of caudal	293	298	305	359	310	290	290
Head from tip of snout	32	31½	31½	30½	31½	32	31
Depth	14½	13	13	13½	13½	14	13½
Orbit	5½	5⅓	5	5	5⅓	5½	5¾
Insertion ventral spine from tip of snout	41	40	40½	39½	40½	42	41
Spinous dorsal from snout	43½	43	43½	43	44	44	44
Soft dorsal from snout	72½	70½	69½	70	71½	70½	70½
Length of pectoral	13	13	12½	13	12½	13	13
Longest dorsal ray	11	11½	11½	11½	11	11½	11½
Longest anal ray	10½	10½	10	10½	10½	10½	10½
Number of dorsal rays and spines	V-I,8	V-I,9	V-I,9	V-I,6	V-I,9	V-I,9	V-I,9
Number of anal rays and spines	II,7	II,8	II,8	II,8	II,8	II,8	II, 8
Number of scales	108	111	109	108	109	112	110

Family POLYNEMIDÆ.

121. **Polydactylus approximans** (*Lay & Bennett*).

Common but much less abundant than *P. opercularis*, and much less valuable than the latter as a food-fish.

Measurements in Hundredths of Length without Caudal.

Length in mm.	217	193	191	206	205
Head	31	32	32	32	32
Depth	29	29	30	28	29
Maxillary	14	14½	14	14½	14
Spinous dorsal from snout	37	39	39	39	39
Distance from front of spinous dorsal to soft dorsal	27	28	30	27	27
Length of pectoral	28	28	29	31	28
Longest detached ray	41	42	45	45	39
Longest dorsal spine	22	22	Broken	24	22
Longest dorsal ray	21	19	21	22	20
Dorsal	VIII-I,12	VIII-I,12	VIII-I,12	VIII-I,12	VIII-I,12
Anal	III,14	III,14	III,13	III,13	III,14
Scales	60	61	60	61	62

122. **Polydactylus opercularis** *(Gill)*.

Taken with hook and line in great abundance. It is eagerly sought after by the native population, by whom it is highly prized. It is one of the most important food-fishes, and on some days equals or exceeds in numbers all others combined.

The type is described as having only eight free pectoral rays, but that was doubtless based on erroneous observation.

Measurements in Hundredths of Length without Caudal.

Length in mm.	280	280	290	242	205	178
Head	31	29½	30½	30	30	30
Depth	25	24	25	25	25½	27
Maxillary	18	17½	17½	17	17½	17½
Spinous dorsal from snout	36	36	35	35½	35	34½
Distance from front of spinous dorsal to soft dorsal	25	26	28	28	26½	26½
Length of pectoral	21	20	21	20½	22	22
Longest detached ray	31	31½	32	33½	32	35
Longest dorsal spine	20	20	19½	20	20½	20
Longest dorsal ray	18	17½	18	18	18	17½
Dorsal	VIII–I, 12	VIII–I, 12	VIII–I, 12	VIII–I, 12	VIII–I, 12	VIII–I, 12
Anal	III, 13	III, 13	III, 13	III, 13	III, 13	III, 13
Scales	66	69	68	70	68	69

Family HOLOCENTRIDÆ.

123. **Myripristis occidentalis** *Gill*.

Two specimens were taken among the islands in the bay. The species differ from *M. pœcilopus* more than has been previously indicated. The teeth are much larger, and the vomerine patch is lance-shaped rather than anchor-shaped. The anterior rays of the dorsal and anal are longer, making these fins more angulated and their posterior margins more nearly vertical. Scales thirty-nine or forty in the lateral line, somewhat smaller than indicated in the type description.

The color of the back is of a clearer reddish brown, less slaty than in *M. pœcilopus*, and with bluish reflections on each scale. The silver begins on the row of scales below the lateral line rather than above, and is richer in coppery and greenish reflections. The dorsal is lighter, and there are no dusky bands at base of caudal and below the lateral line, as in *M. pœcilopus*. The ventrals have lighter or colorless tips. In one specimen the ventrals are immaculate, in the other a slightly dusky tinge is present. The three specimens of *M. pœcilopus* have the tips of the ventrals darker, running from dusky to black. There is a dark pigment spot above pupil in *M. occidentalis*, which is absent or very slightly dusky in *M. pœcilopus*.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm...	45	46
Head................................	35	35
Depth	37	36
Eye.......................	15	15
Snout....................................	7½	7½
Length of pectoral.................	22	24
Length of ventral...................	22	23
Height of soft dorsal.............	18	16
Height of anal	18	16
Length of caudal	24	24
Number of dorsal rays...........	X–I, 14	X–I, 14
Number of anal rays..............	IV, 12	IV, 12
Scales	3–40–7	3–39–7

124. Myripristis pœcilopus *(Gill)*.

Three specimens taken.

Very small villiform teeth on jaws, vomer, and palatines; the palatine patches very long and narrow, the vomerine patch anchor-shaped, its length about three times its width across lateral arms. The median backwardly extending limb is narrow and pointed.

Color of back slaty brown, passing into bright, iridescent silvery at the upper part of the band of scales which bears the lateral line. Upper end of opercle with bluish reflections. Directly below the lateral line is a narrow, straight, dusky streak, commencing three or four scales from gill-opening and ending a little behind tip of pectoral. Tips of ventrals varying from slightly dusky to black. Base of caudal with a dusky band. Spinous dorsal dark or nearly black. Other fins colorless.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm..	50	44	45
Head	34	35½	35
Depth	35	33	35
Eye	14	15	15
Snout	7½	8	8
Length of pectoral	20	21	21
Length of ventrals	20	20	21
Height of soft dorsal	15	15	15
Height of anal	15	15	16
Length of caudal	22	23	23
Number of dorsal rays	X–I, 14	X–I, 14	X–I, 14
Number of anal rays	IV, 12	IV, 12	IV, 12
Scales	3–35–7	3–35–7	3–34–7

125. **Holocentrus suborbitalis** *Gill.*

Taken in abundance in the rock-pools. Our specimens do not materially differ from the description of the type. The statement that "the tail behind the vertical fins nearly equals a ninth of the total length" should doubtless read "the height of the caudal peduncle behind the vertical fins nearly equals a ninth of the total length." The length of the tail behind the vertical fins is about 3½ in the total length.

Measurements in Hundredths of Length without Caudal.[1]

Length without caudal in mm	153	145	150	112	110	65	68
Head	32	32	32	32	31	35	34½
Depth	37	37	38	38	37	39	38
Orbit	11	12	11½	12	12	14	14
Maxillary	13	13	12½	13	13	15	14½
Preopercular spine	8½	8½	8	7	6½	5½	7
Third anal spine	19	17	19½	21	20	22	22
Third dorsal spine	17	17	18½	19	17½	20	19
Base of soft dorsal	13½	14½	14	13½	14	14½	14½
Length of pectoral	22	23	24	25	25	27	27
Length of ventral	21	22	24	24	24	26	25
Dorsal	XI–13	XI–14	XI–14	XI–14	XI–14	XI–14	XI–14
Anal	IV, 9	IV, 9	IV, 9	IV, 9	IV, 9	IV, 9	IV, 9
Scales	39	38	38	38	37	37	37

---

[1] In this table, the head is measured to the angle formed by largest opercular spine and edge of subopercle. The preopercular spine is measured along its upper edge from its angle with preopercle.

Family MULLIDÆ.

126. Upeneus grandisquamis *Gill.*

Several specimens collected in the Panama market. This large series enables us to add the following range of variations to the original description:

Head 3⅕ to 3½ in length without caudal; depth 3 to 3⅖. Eye 4½ to 5 in head; snout 2 to 2⅙. The fin counts in our eleven specimens are constantly VIII–I, 8 for the dorsal, and I, 6 for the anal. The third dorsal spine is longer than the fourth, but does not project beyond it. Sometimes it does not reach its tip.

Dr. Gill's measurement of the length of the spinous dorsal fin includes the membrane which connects the last spine to the body. As most specimens have this membrane broken, we have considered the base of the fin to extend to the base of the last spine. The base of the first dorsal equals or sometimes slightly exceeds the interval between the dorsals, the latter equaling or sometimes slightly exceeding the base of the second dorsal. The interval between the dorsals contains 4 scales along the median line.

The following color description was taken from a fresh specimen: Red above, silvery below; 2 silvery streaks along the sides anteriorly, follow the rows of scales above and below the lateral line, and are continued forward on the head to a point behind the eye. Other silvery streaks follow the rows of scales, but are much less conspicuous. Dorsal and caudal deep orange-red with wide translucent margins.

Measurements in Hundredths of Length without Caudal.

Length without caudal, in mm.	160	154	145	142	121
Head	32	30	31	29½	30
Depth	32	29	29	29	30
Snout	15	14	14	14	14
Eye	7	6½	7	6½	7½
Length of 3d dorsal spine	21	21	20	19½	19
Length of pectoral	25	23½	25	23	24
Height of second dorsal	12	12½	13	13	13
Spinous dorsal from snout	40	38½	39	38	38
Front of first dorsal to front of second dorsal	29	30	28	29	28½
Number of gill-rakers	6+11	6+11	6+11	6+12	6+11
Number of dorsal rays	VIII-I,8	VIII-I,8	VIII-I,8	VIII-I,8	VIII-I,8
Number of anal rays	I,6	I,6	I,6	I,6	I,6
Scales	2-30-5	2-30-5	2-31-5	2-31-5	2-30-5

Family SCOMBRIDÆ.

127. Sarda chilensis *Cuvier & Valenciennes.*

Abundant in the market for two or three days, but not again seen. We preserved one specimen, 46 cm. in length.

Eighteen gill-rakers are attributed to the horizontal limb of the anterior branchial arch by Jordan & Evermann, 1896, p. 872. They also describe the maxillary as not reaching the eye. In our specimen there are but nine gill-rakers including one rudiment; and the maxillary extends to below the posterior border of the eye.

128. Scomberomorus sierra *Jordan & Starks.*

This species is brought into the market daily, and is one of the most important food fishes. We preserved six specimens.

If it is distinct from its East Coast relative, *S. maculatus*, it is separated by only slight characters, and a large series from both shores will have to be compared accurately to define the species. The chief character that has been alleged to separate the two is the more backward position of the dorsal in *S. sierra*. Our material shows this character to be valueless.

We have but three specimens of *S. maculatus*. From these, *S. sierra* seems to differ in being a little more slender, and in having the spots rounder and more numerous below the lateral line. As the appended table indicates, the size of the head and eye may average smaller, the number of dorsal rays less, and the number of gill-rakers more. *S. sierra* has 3 or 4 rows of spots below the lateral line, while *S. maculatus* has but two, or at the most, the beginning of a third.

We do not admit to our list *S. concolor*, recorded without comment from the Gulf of Panama, by Boulenger, 1899, p. 3. Aside from this record, *S. concolor* has been known only from Monterey Bay, California.

Measurements in Hundredths of Length without Caudal.

Species	SCOMBEROMORUS SIERRA							S. MACULATUS		
Locality	*Mazatlan* (TYPE.)	*Panama*						*Florida*		
Length without caudal	307	305	305	325	305	350	282	285	205	185
Head	22	22	23	22	22	22	22½	23	23½	24
Depth	21½	20	20½	20	20	19	18½	22	22½	22
Orbit	4	4	4	4	4	4	4	4	4½	4½
Maxillary	12½	12	12	12	12	12½	12	13	13	13½
Snout to first dorsal	26	26½	27	26	25½	26	26½	26½	26½	27
Snout to second dorsal	55½	54	55	54	54½	53	55	52	54½	53
Snout to anal	57	56½	60	57	57	57½	58	56	57	57
Length of pectoral	13½	14	14	14	14	14	13½	14	13½	13
Height of soft dorsal	12	12	12	13	12	12½	11	Broken	Broken	Broken
Height of anal	Broken	12	11½	12	11	12	11	"	"	"
Length of caudal	28	27	28	27	28	28	26	27	"	"
Number of dorsal rays	XVIII-16-IX	XVII-16-IX	XVII-16-IX	XVII-17-IX	XVII-16-VIII	XVIII-16-IX	XVII-17-VIII	XVII-18-IX	?-17-VIII	XVII-17-IX
Number of anal rays	II-15-IX	II-15-IX	II-15-IX	II-16-IX	II-16-VIII	II-16-VIII	II-15-VIII	II-16-IX	II-15-IX	II-16-IX
Number of gill-rakers	3+12	3+12	3+11	4+13	4+11	4+10	3+11	2+10	3+11	3+9

Family TRICHIURIDÆ.

129. **Trichiurus lepturus** *Linnæus.*

Recorded from Panama by Jordan and Bollman, 1889, p. 180.

Family NEMATISTIIDÆ.

130. **Nematistius pectoralis** *Gill.*

Probably rare as far south as Panama; only three or four seen.

The following measurements are from a specimen 30 cm. in length.

Head $3\frac{2}{3}$ in length; depth $3\frac{1}{5}$. Eye 5 in head; snout $3\frac{7}{8}$; maxillary $2\frac{1}{10}$; interorbital (bone) $3\frac{3}{4}$. Dorsal VIII-I, 26; anal I, 16. Gill-rakers 3+9, the longest two-thirds the diameter of the eye.

Family CARANGIDÆ.

131. **Oligoplites saurus** (*Bloch & Schneider*).

Not uncommon in the market, though much less abundant than *O. mundus.*

The top of head and nape are smooth and without conspicuous pores in *saurus* and there is no membrane connecting the anterior branchiostegal rays of the two sides. Our material shows that no reliable character can be drawn from the comparative size of the lowest suborbital bone and the next above. In *saurus* the lowest suborbital seems constantly narrower than the one above it, but they vary greatly in size, sometimes differing on opposite sides of the same specimen. Larger specimens have proportionately deeper bodies, so this character also must be used with caution.

We have compared our material with specimens from the Atlantic, and can appreciate no difference whatever.

Measurements in Hundredths of Length without Caudal.

Locality	*Panama*									*Mazatlan, Mex.*	*Jamaica*				*Florida*
Length without caudal in mm.	200	202	209	212	217	215	232	228	232	113	177	192	202	204	106
Head	22	21½	21	22	21½	22	22	22	22	21½	22	23	22	23	22
Depth	27½	27½	27	27½	27	30½	29½	29½	30	27	26	26½	27	27½	26
Eye	4½	4½	4½	4½	4½	4½	5	4½	4½	5	4½	4½	4½	5	5
Maxillary	12	12	12	12½	12	12½	12	11½	12	12½	12	12½	12	12½	13
Snout to posterior margin of eye	10½	10½	11	11	11	11	11	10½	11	11	11½	12	11	12	12
Snout to soft dorsal	49	49	49	49	49	50	49	49	50	48	49	52	49	51	49
Snout to anal	50	50	49	49	50	50	49½	49	51	48	49	51	50	51½	50
Length of pectoral	13½	13½	13	13½	13½	14	14	13½	14½	14	13	13½	13	13½	13½
Length of caudal	21	22	22½	22	22	23	23	22	23	21	21	22	22½	22½	....
Height of dorsal	11½	11½	11	12	11½	11½	11	11	11½	13	11½	11½	12	12½	11
Height of anal	9½	9½	9½	10	10	10	9	10½	10½	10	9½	9	9½	9½	8½
Number of dorsal rays	VI-I, 20	V-I, 20	V-I, 20	IV-I, 20	V-I, 20	VI-I, 20	V-I, 20	IV-I, 20	V-I, 20	V-I, 20	VI-I, 19	V-I, 20	V-I, 20	V-I, 20	IV-I, 20
Number of anal rays	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 19	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 20	II-I, 20
Gill-rakers above angle of arch.	5	4	4	5	5	5	5	5	5	5	4	4	4	4	5
Gill-rakers below angle of arch.	14	14	14	14	14	14	15	14	14	15	14	14	14	14	15

132. Oligoplites altus (*Günther*).

PLATE XI, FIG. 20.

One specimen taken in the Panama market.

Head 4⅓ in length without caudal; depth 3¼. Eye 4½ in head; snout 3¾; maxillary 1⅔. The interorbital width equals the diameter of the eye. Dorsal V–I, 19; anal II–I, 20.

Body moderately deep, as in specimens of *O. saurus* of equal size; contour very slightly angulated at front of soft dorsal and anal. Mouth large, the maxillary reaching slightly past eye. The bands of teeth on jaws are wider than in either *O. saurus* or *O. mundus*, and differ from them in having the outer row of the lower jaw composed of slender movable teeth which are more or less in contact and project above the other teeth. They are bluntly rounded as viewed from the side, but are laterally compressed to a sharp cutting edge. The width of the mandibular band of teeth anteriorly is about a fourth of the diameter of the eye or one-fourth wider than maxillary near the posterior end. The premaxillary band is somewhat narrower. The patch of vomerine teeth is rounded in front and acutely pointed behind; its length about half the diameter of the eye, its width about two-thirds of its length. The palatine patches are about half as wide as the vomerine patch. Gill-rakers moderately slender, their length about two-thirds eye. Top of head and nape with pores, as in *O. mundus*. Anterior branchiostegal rays connected across isthmus by a thin transparent membrane.

The anterior rays of dorsal are a little longer than those of anal. The last rays of dorsal and anal are produced; those of anal a little longer, barely reaching to the short anterior caudal rays. Pectoral about 1⅔ in head; its tip reaching slightly past tips of ventrals. Origin of ventrals nearer front of anal (behind detached spines) than tip of lower jaw by about half eye. Caudal lobes subequal.

Color not unlike *O. mundus*. Back slaty-brownish, lower parts and sides silvery. Top of head to tip of snout dark; tip of mandible black. Pectoral fin dusky on inner face, growing darker or black at base. Dorsal and caudal dusky, median rays of caudal darker at tips. Ventral and anal white.

This species differs from *O. mundus* in having a smaller mouth, a more slender body, and in the character of the teeth in the lower jaw. Dr. G. A. Boulenger has kindly re-examined for us the type of *O. altus* in the British Museum, and informs us that the top of the head is densely beset with pores, and the anterior branchiostegal rays of the two sides are joined by membrane. There can be no question, therefore, as to the correct identification of our specimen.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm.	225
Head	23
Depth	30
Eye	5
Maxillary	14
Snout to posterior margin of eye	$11\frac{1}{2}$
Snout to soft dorsal	49
Snout to first anal ray	50
Length of pectoral	16
Length of caudal	27
Longest dorsal ray	$12\frac{1}{2}$
Longest anal ray	$10\frac{1}{2}$
Number of dorsal rays	V–I, 19
Number of anal rays	II–I, 20
Number of gill-rakers	4+10

133. **Oligoplites refulgens** sp. nov.

PLATE XI, FIG. 19.

Head $4\frac{3}{5}$ in body without caudal; depth $4\frac{4}{7}$. Eye $4\frac{1}{4}$ in head; maxillary $2\frac{1}{4}$; snout $3\frac{1}{2}$. Interorbital width little exceeding diameter of eye. Dorsal V-I, 20; anal II–I, 19.

Body more elongate than in other members of the genus; the ventral and dorsal outlines similar and symmetrical, without angles at origin of dorsal and anal fins.

Head pointed; its greatest width $2\frac{1}{4}$ in its length; its depth at point of occipital crest a little anterior to edge of opercle, $1\frac{1}{4}$ in its length. Mouth comparatively small; its outline curved upward anteriorly and downward posteriorly; lower jaw slightly the longer; maxillary scarcely reaching to below middle of eye. Teeth on jaws in narrow bands which are scarcely as wide as exposed portion of maxillary anteriorly. Bands on vomer and palatines wide, that on vomer about $1\frac{2}{3}$ as long as it is wide, its greatest width in its anterior third or fourth; palatine bands at least twice as wide as those on jaws. Tongue with minutely granular patches.

Head entirely scaleless. Scales on body about as in the most conspicuously scaled examples of *O. saurus*. Top of head and nape smooth as in *O. saurus*, without the conspicuous pores of *O. mundus* and *O. altus*.

Insertion of ventrals about midway between base of first anal spine and the vertical from anterior orbital rim; their tips reaching over half way to second anal spine. Pectoral extending to tips of ventrals. Longest anterior dorsal ray a little longer than longest anal ray. Last ray of dorsal and anal elongate, that of the anal the longer, reaching rudimentary caudal rays. Caudal rather short, the lobes equal; its longest ray $1\frac{1}{3}$ in head.

Sides bright silvery; top of head and snout nearly black; extreme tip of lower jaw black. Two very dark brown or blackish bands run parallel along the back and upper part of sides; the lower sharply defined below by the silvery of the sides, passing gradually above into dusky silvery. The upper band is uniform in color and joins its fellow of the opposite side, forming a well defined median band on back as viewed from above. Dorsal spines and anterior part of soft dorsal blackish; anal slightly dusky anteriorly, its spines white. Ventrals white; pectoral dusky on inner face, growing darker towards base. Upper and lower edges of caudal dusky; the upper the darker.

A single specimen, 22 cm. in entire length, was taken in the Panama market.

Measurements in Hundredths of Length without Caudal.

Length without caudal	203
Head	21½
Depth	22
Eye	5
Maxillary	9½
Snout to posterior edge of eye	11
Snout to soft dorsal	49
Snout to anal	51
Length of pectoral	12½
Length of caudal	18
Length of longest anterior dorsal ray	8½
Length of longest anterior anal ray	7
Number of dorsal rays	V–I, 20
Number of anal rays	II–I, 19
Number of gill-rakers	6+17

134. **Oligoplites mundus** *Jordan & Starks.*

In the Panama market this species is more abundant than any other of the genus.

O. mundus resembles *O. altus*, and differs from that division of the genus to which *O. saurus* and *O. refulgens* belong in having the top of its head and nape closely covered with pores, which open into short canals ramifying beneath the skin. In a large specimen from Mazatlan, about 16 inches in length, these pores and canals are very conspicuous and extend posteriorly in a patch on side of back to a point above the anterior third of the pectoral fin. *O. mundus* and *O. altus* have also the anterior branchiostegals connected across the isthmus by a thin, but tough transparent membrane. The bands of teeth on the jaws are wider, the body is deeper, and the caudal is longer.

Measurements in Hundredths of Length without Caudal.

Locality	*Panama*					*Algodones Lagoon, Mex.*		*Mazatlan, Mex.*
Length without caudal in mm.	198	210	205	208	174	209	151	385
Head	25	25½	26½	26	26	26	25½	24½
Depth	35	34	36	35	36½	34	33	35
Eye	5	5½	5¼	5	5½	5	5½	4
Maxillary	17½	17½	17½	18	18	17½	17	16
Tip of snout to posterior edge of eye	11½	11½	12	12	12	12	12	10½
Tip of snout to soft dorsal	51	52½	53	53	53	52	51	51
Tip of snout to anal	52	53	54½	55	55	52½	52	51
Length of pectoral	16½	17½	17	16½	16½	17½	16	16
Length of caudal	25	27	28	26½	27	27	25½	24½
Height of dorsal	15½	16	16	16	15	16	15	14
Height of anal	15	15	15	14	14	15	14	13½
Number of dorsal rays	IV-I, 19	IV-I, 20	IV-I, 20	V-I, 19	IV-I, 18	V-I, 20	IV-I, 19	V-I, 20
Number of anal rays	II-I, 19	II-I, 20	II-I, 19	II-I, 19	II-I, 18	II-I, 20	II-I, 19	II-I, 20
Number of gill-rakers above angle	3	3	4	4	3	4	3	4
Number of gill-rakers below angle	10	11	10	10	9	10	10	10

135. Trachurops crumenopthalmus (*Bloch*).

Occasionally brought to market, where numerous specimens were collected. It was also observed at Acapulco. We are unable to find any differences between specimens from the Atlantic and the Pacific.

The head varies from $3\frac{1}{6}$ to $3\frac{1}{3}$ in length; the depth from $3\frac{1}{4}$ to $3\frac{2}{3}$; the pectoral from $3\frac{1}{3}$ to $3\frac{2}{3}$. Orbit $2\frac{5}{6}$ to $3\frac{1}{6}$ in head; maxillary $2\frac{1}{4}$ to $2\frac{1}{3}$; ventral 2 to $2\frac{1}{4}$. Plates and scales along the entire lateral line vary from 86 to 91.

136. Hemicaranx atrimanus (*Jordan & Gilbert*).

Of frequent occurrence in the Panama market, where it appeared sometimes in considerable numbers.

As the original description was taken from a single specimen, we append the following notes giving a wider range of variation.

Head $3\frac{3}{4}$ to $4\frac{1}{4}$ in length; depth $2\frac{1}{3}$ to $2\frac{3}{4}$; length of pectoral $2\frac{1}{2}$ to $2\frac{3}{4}$; chord of curve of lateral line $3\frac{1}{2}$ to 4; straight part of lateral line $1\frac{5}{6}$ to 2. Orbit $3\frac{1}{5}$ to $4\frac{1}{3}$

in head; maxillary $3\frac{1}{4}$ to $3\frac{2}{5}$; ventrals $1\frac{1}{5}$ to $2\frac{1}{6}$; highest dorsal spine 3 to $3\frac{1}{2}$; second dorsal ray $1\frac{3}{4}$ to 2. Length 23 to 36 cm.

The following color description was taken from a fresh specimen: Back deep blue, with faint traces of cross-bars. Snout and opercles dusky. Cheeks dusky yellow, with coarse brown specks. Lower part of sides silvery, with some dusky shading and without yellow. Caudals and pectorals light lemon-yellow, the caudal narrowly edged with black. Pectorals with a jet-black blotch involving base and axil of fin and basal portion of all except the lowest rays. Dorsal, anal and ventrals orange-yellow, more or less dusky; dorsal inconspicuously margined with black.

137. Hemicaranx zelotes *Gilbert.*

PLATE XII, FIG. 22.

Hemicaranx zelotes GILBERT (JORDAN & EVERMANN, 1898, p. 2845).

Closely related to *atrimanus*, with which it agrees in having a large jet-black area on axil and base of pectorals. It differs from *atrimanus* in the following characters: The more rounded profile of snout; the lower spinous dorsal; the longer maxillary; the higher, shorter curve in the lateral line; the wider scutes, which are also fewer in number; the darker coloration of body and fins.

Head 4 to $4\frac{3}{5}$ in length; depth, $2\frac{2}{5}$ to $2\frac{3}{5}$; D. VII–I, 26 to 29; A. II–I, 23 to 25; P. 20 to 22. Scutes 51 to 53 (over 60 in *atrimanus*).

Body regularly elliptical, its greatest depth about in the middle of its length, exclusive of caudal peduncle. Head small; anterior profile more decurved, the snout hence blunter than in *atrimanus;* depth of head just behind eye about five-sixths its length. Jaws subequal, the tip of the lower slightly projecting; maxillary narrow, not quite reaching anterior margin of pupil, about $3\frac{1}{6}$ in head ($3\frac{1}{3}$ in *atrimanus*). A single series of small, close-set subequal teeth in each jaw; no teeth on vomer, palatines, or tongue. Orbit considerably greater than snout, $3\frac{1}{3}$ to $3\frac{4}{7}$ in head. Interorbital width (taken at anterior margin of orbit) slightly less than orbit. Occiput with an evident carina. Distance from snout to first dorsal spine greater than length of pectorals.

Spinous dorsal very low, the highest spine considerably less than orbit (greater than orbit in *atrimanus*). A well developed antrorse spine before the dorsal. Soft dorsal and anal similar, not falcate; the rays decreasing in size from the first; the highest ray of the soft dorsal 2 to $2\frac{1}{2}$ in head; the highest ray of the anal about $2\frac{1}{3}$ in head. Dorsal and anal depressible into a sheath of scales, the last 3 or 4 rays uncovered. Caudal fin wide, well forked, the upper lobe the longer, the longest ray not quite one-fourth total length of body. Pectoral fin long, falcate, but much shorter than in *atrimanus*, $3\frac{1}{8}$ to $3\frac{5}{7}$ in body ($2\frac{2}{3}$ to $2\frac{1}{7}$ in *atrimanus*). Ventrals $2\frac{2}{3}$ to $2\frac{3}{5}$ in head. Scales as in *atrimanus.*

Lateral line with a very strong curve anteriorly, the height of the curve $2\frac{2}{3}$ to $3\frac{1}{8}$ in its length; its length $2\frac{1}{8}$ to $2\frac{1}{4}$ in the straight portion. The entire length of the straight portion is furnished with scutes, which are very small in front and behind. The scutes are considerably wider and lower than in *atrimanus:* the widest about one-half the diameter of orbit (about one-third diameter of orbit in *atrimanus*).

Coloration much as in *atrimanus*, but darker and the fins without yellow. Blackish olive above, dusky silvery below, top of head and snout black. Spinous dorsal black; soft dorsal and anal black, except a narrow light streak at base. Caudal dark, margined with black; pectorals very dark, black on inner face, the extreme lower rays light. A large jet-black blotch covers the base of the pectorals and extends for about one-fifth of the whole length of the fin; the axil is also black.

Four specimens were obtained in the market at Panama; none others were seen.

138. **Hemicaranx furthii** (*Steindachner*).

Only the types known, from Panama. Probably not distinct from *H. leucurus*.

139. **Hemicaranx leucurus** (*Günther*).

Only the type known, from Panama.

140. **Caranx vinctus** *Jordan & Gilbert*.

But few specimens were seen, four of these preserved. They agree well with the description of the type. The measurement of the eye in the original description is evidently of the entire orbit. Between the adipose eyelids, the eye is 5 to $5\frac{1}{3}$ in head.

141. **Caranx hippos** (*Linnæus*).

We have compared seven specimens from Panama and Mazatlan with five specimens from Jamaica and Cuba. The Pacific examples seem to differ slightly in having an average larger number of gill-rakers and more plates in the straight part of the lateral line. In five of the seven Pacific specimens, the ventrals end considerably in advance of the vent; in one specimen they reach the vent, and in one they extend beyond it. The Atlantic specimens all have the ventrals reaching to or a little past the vent. The Panama specimens are all a little more slender than the Atlantic or Mazatlan specimens. It is not probable that these differences have any importance for classification.

Measurements in Hundredths of Length without Caudal.

Locality	*Panama*					*Mazatlan, Mex.*		*Jamaica*				*Cuba*
Length in mm. without caudal	252	204	260	261	254	185	177	200	200	193	172	228
Depth at base of ventrals	32	34	30½	32½	31	36½	36	35½	36	36	35	38
Distance from base of ventrals to 1st detached anal spine	20½	21½	21½	22	21	21½	19	20½	21	20½	20	20½
Distance from vent to base of ventral fins	14½	16½	16	16½	15	15	14	14	14½	14	13½	13½
	Ventrals reach vent.	Ventrals end a little before vent.					Ventrals cover vent.	Ventrals reach to or a little past vent.				

Table of gill rakers and plates of straight part of lateral line.

Locality	*Panama*					*Mazatlan*		*Jamaica*				*Cuba*
*Gill-rakers	16 + 2	16 + 2	16 + 1	16 + 2	15 + 2	16 + 1	16 + 1	14 + 2	15 + 2	14 + 2	15 + 2	14 + 2
Plates	39	42	41	37	38	39	38	33	35	36	32	36

142. Caranx caballus (*Günther*).

Frequently appearing in considerable numbers; seven specimens preserved. These, in addition to three specimens from Mazatlan, have been compared with four specimens of *C. crysos* from the Atlantic (two from Jamaica; one from Woods Hole, Mass.; one from Florida).

C. caballus seems to be more slender, the depth varying from $3\frac{1}{4}$ to $3\frac{1}{8}$ (3 to $3\frac{1}{6}$ in *C. crysos*). The former has two or three of the plates on the caudal peduncle lengthened antero-posteriorly. Counting from a point opposite the base of the last dorsal ray to opposite the beginning of the short outer rays of the caudal, they number four or five in *C. caballus*, and seven or eight in *C. crysos*.

The two species do not differ in length of the pectoral or in the number of plates in the straight part of the lateral line, as has been alleged. In both, the pectoral varies from $2\frac{3}{4}$ to $3\frac{1}{6}$ in the length, and the plates from 47 to 50.

143. Caranx marginatus *Gill*.

Common in the Panama market. We supplement the description given by Jordan and Evermann (1896, p. 922) as follows:

Head from $3\frac{1}{7}$ to $3\frac{1}{4}$ in length; depth $2\frac{3}{4}$ to 3. Dorsal in four specimens VIII–I, 21; in two specimens VIII–I, 20. Anal in four specimens II–I, 16; in two specimens II–I, 17. Eye (iris) 4 to $4\frac{1}{3}$ in head; maxillary 3 to $3\frac{1}{5}$, reaching to below posterior border of pupil. The gill-rakers number 4 or 5 + 14 or 15. Pectoral $2\frac{5}{6}$ to 3 in body. Arch of lateral line $1\frac{2}{5}$ to $1\frac{3}{5}$ in its straight portion. Plates in straight part of lateral line in two specimens 30, in three specimens 31, in one specimen 32.

We have specimens in the collection of Stanford University from Mazatlan, Socorro Island and the Galapagos Islands, which agree with our Panama specimens in all respects.

Doubtless all of the records of the occurrence of *C. latus* in the Pacific are referable to either *C. marginatus* or *C. medusicola*. *C. marginatus* differs from *C. medusicola* and *C. latus* in having a slenderer form, and fewer plates in the lateral line.

We have re-examined the two type specimens of *C. medusicola* from Mazatlan, and also several specimens from Clarion Island. None of them exceed 7 inches in length. From *C. latus* of the same size (of which we have specimens from Key West, St. Lucia and Bahia, Brazil), *C. medusicola* differs in the following respects:

---

* Gill-rakers given for lower arch only; the rudiments enumerated separately in each case.

The maxillary is shorter, $2\frac{3}{5}$ to $2\frac{1}{2}$ in head (2 to $2\frac{1}{5}$ in *C. latus*). The preorbital is wider, in the narrowest part two-thirds the diameter of the eye (half eye in *C. latus*). The snout is longer, from $2\frac{9}{10}$ to 3 in head ($3\frac{3}{5}$ to $3\frac{2}{3}$ in *C. latus*). The gill-rakers are more numerous, 4 + 17 or 18 (4 + 14 or 15 in *C. latus*). It has 1 or 2 more soft rays in the dorsal and anal, 22 or 23 dorsal rays, 18 anal rays (20 or 21 dorsal rays, and 16 or 17 anal rays in *C. latus*). One of the Mazatlan specimens is deeper than any specimen we have seen of *C. latus*, the others are of the same depth.

The figure of *C. medusicola* given by Jordan (1895 *b*, plate 34), shows the characters of this species very well, except that the preorbital is not wide enough. In the original description, the number of the dorsal spines, gill-rakers, and lateral plates is wrongly given. The first dorsal has 8 spines, the plates to the bend in the lateral line number from 36 to 38.

Measurements in Hundredths of Length without Caudal.

Species	C. MEDUSICOLA				C. LATUS		
Locality	*Mazatlan* (TYPES.)		*Clarion Island*		*Bahia, Brazil*	*Key West, Florida*	
Length without caudal in mm	98	123	133	139	103	111	108
Head	31½	30½	32	32½	33	32½	32
Depth	46½	42½	40	42½	43	43	43
Snout	10½	10½	11	11½	9	9	9
Least width of preorbital	4	4	4½	4½	3	3	3
Maxillary	12½	12	13	12½	15	15	15½
Eye	8	7½	7½	7½	8	8	8
Chord of curve of lateral line	30	30	30	30	28	30	30
Straight part of lateral line	41½	41½	42	42	45	43	45
Number of soft dorsal rays	22	22	22	23	21	20	21
Number of anal rays	18	18	18	18	17	16	17
Plates in straight part of lateral line	36	36	37	38	37	36	35

144. Gnathanodon speciosus (*Forskål*).

Appearing infrequently; on two occasions many large ones were brought to market. Our five specimens all have 19 rays in the dorsal and 16 in the anal.

145. Citula dorsalis (*Gill*).

Frequently brought to market. We preserved seven specimens from 24 to 36 cm. in length. To the description given by Jordan and Evermann (1896, p. 930), we make the following additions and corrections, based upon our material.

Depth from $1\frac{1}{5}$ to 2 in length. Eye $4\frac{1}{8}$ to $4\frac{2}{3}$ in head; snout $2\frac{3}{4}$ to 3. Pectoral one-fourth to one-fifth longer than head. Ventrals reaching well past vent, about half the distance from their insertion to the third anal spine. Length of gill-rakers a little over half diameter of eye, their number 6 + 16. In three specimens the dorsal rays number 19 and the anal 17; in three the dorsal is 18 and the anal 16, and in one the dorsal is 19 and the anal 16. Scales in the straight part of lateral line 48 (not 58).

146. **Alectis ciliaris** (*Bloch*).

But few of this species were seen. We have compared our material with a single specimen from Jamaica and can appreciate no differences.

147. **Vomer setipinnis** (*Mitchill*).

Brought into the market almost daily, sometimes in large numbers. We preserved nine adult specimens and several young; the latter were taken in the tide-pools.

We have compared our adult specimens with three specimens from Beaufort, N. C., and a single large specimen from Jamaica. From the former, ours differ in the following respects: The body is more slender, the declivity of the anterior profile is less steep, the space between the eye and the angle of profile above eye is shorter, the bases of the anal and soft dorsal are shorter, and the scutes on the caudal peduncle are larger. They differ from the Jamaica specimen only in having larger scutes. We have compared the young with specimens of the same size from Galveston and find them similar. The specimens from Beaufort seem to occupy a position between the Panama specimens and *V. spixii*.

Our material from the Atlantic is so meagre that we are unable to decide whether the species from the Pacific is distinct or not.

Measurements in Hundredths of Length without Caudal.

Locality	*Beaufort, N.C.*			*Jamaica*	*Panama*							*Galveston*	
Length without caudal in mm	150	164	138	248	159	225	204	172	204	63	66	65	66
Head	33	33	33½	33	34½	32	34	33½	32½	39	38	38	38
Depth	55	57	58	51½	50½	50	48½	52	51	68	63	66	65
Maxillary	13	13	13	13½	13½	13	13	13	13	14	13	14	14
Eye	8	7½	7½	8	8	7	7	8	7½	9½	9	10	9½
Eye to middle of upper curve of head	16½	16	17	13½	13	13	12½	13	12½	18	17	19	19
Eye to anterior tip of maxillary	15	15½	15½	14	14½	13½	13	14	13½	18	17	20	18
Least distance from eye to anterior profile	6½	6½	7	6½	7	7	7	7	6½	7½	7	7½	7
Eye to opercular angle	11½	12	11½	12½	13	12½	13	12½	12½	13½	12	11	12
Straight part of lateral line from base of middle caudal rays	40	41	41	41	39	41½	42	40½	43	40	38	37	37
Chord of curve of lateral line	34½	31	33	33	32	32	30	31	31	29	28	32	33
Length of soft dorsal base	45	46	46	44½	42½	44½	43	44	44	46	45	45	46
Length of anal base	53	54	52	48	48	48	48	48	48	55	52	54	53
Length of pectoral	34	35	37	34	38½	37	38	40	38	37	36	35	34
Length of caudal	Bro ken.		......	29	29	28	29	30	28	30	28	32	30

148. Selene œrstedii *Lutken.*

Common; brought into the market almost daily with *S. vomer.* It may be at once distinguished from all other members of the genus by the occipital region being scarcely angulated, and by the comparatively large ventral fins.

The following description is from a specimen 31 cm. in length.

Head 2⅔ in length; depth 1⅔. Eye 4 in head; snout 2; maxillary 3⅛. Dorsal VI, I, 18; anal II, I, 15. The profile of snout is less nearly vertical than that of head in front of eye, with which it forms a slight angle just below the level of the eye. In smaller examples the angle is less noticeable. The upper profile forms a broad even curve from just above eye to spinous dorsal. The outline of the body is angulated at front of soft dorsal and anal.

Teeth small, blunt, and not much crowded, in bands on jaws and palatines, in a quadrangular patch on vomer. Preorbital space contained 3 times in postorbital space. Gill-rakers contained 2½ times in diameter of eye; their number 4 + 14.

The pectoral reaches to above eleventh or twelfth anal ray, or to within twice the diameter of the eye of the base of the middle caudal rays. The ventrals reach to the first detached anal spine; in specimens 21 cm. in length, they reach to the first anal ray; in specimens 11 cm. long, they reach to the caudal rays and are about half the length of the entire body. Anterior dorsal and anal rays filamentous. Second dorsal spine as long as the maxillary, reaching when fin is depressed, two-thirds the distance between its base and the front of the soft dorsal. In a specimen 11 cm. in length it is longer than the head by a distance equal to the diameter of the eye.

Color silvery with bluish reflections above. Spinous dorsal and front of soft dorsal dusky; other fins colorless. In specimens 21 cm. in length or less, the distal half or more than half of the ventrals is black.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm....	243	150	160	86
Head..................................	37	37	39	42
Depth.................................	60	66	68	73
Eye....................................	9½	9	9	10
Snout	19	20	20½	22
Length of pectoral	46	47	46	43
Length of ventrals..................	11½	20	17	60
Length of caudal....................	36	38	40	37
Length of dorsal base.............	45	48	47	45
Length of anal base................	43	43	44	45
Number of dorsal rays	VI–I, 18	VII–I, 17	VII–I, 18	
Number of anal rays...............	II–I, 15	II–I, 15	II–I, 15	II–I, 15

149. Selene vomer (*Linnæus*).

Common at Panama. We have compared our specimens with others from Florida and Jamaica, and find only individual differences.

150. Chloroscombrus orqueta *Jordan & Gilbert.*

Frequently taken in abundance. We have compared our specimens with the original description (Jordan & Gilbert, 1882, *o*, p. 646) and with specimens of *C. chrysurus.*

The depth is very variable; in our most slender specimens the depth is $2\frac{2}{3}$ in the length, while in the deepest specimen (of the same length) it is $2\frac{1}{3}$. Between these extremes are all intermediate shapes.

151. Trachinotus rhodopus *Gill.*

Not abundant; eight specimens preserved, from 15 to 36 cm. in length.

We have compared them with a single specimen of *T. glaucus* from Key West. In addition to the less vertical snout noted by Dr. Gill, they differ in having much longer, slenderer, and more numerous gill-rakers. The scales appear to be smaller, and the dorsal and anal are probably slightly longer.

The dorsal formula in seven specimens is VI, I, 20, in one specimen VI, I, 19; the anal in three specimens III, 19, in five specimens III, 18. The gill-rakers are long and slender, and do not greatly taper in size from their base to their tips.

They number 14 or 15 on the lower limb of the arch, and in length are from three-fifths to two-thirds the diameter of the eye.

The character of width or position of the cross-bars is without value. In one of our small specimens, the second bar on one side occurs directly midway between the first and second bars on the reverse side, while the third bar is only a little behind the second bar of the reversed side. The first two bars are not always nearer together than the others, as described by Jordan and Evermann. The bars are not so conspicuous in our small specimens as in the large ones, but they are evident.

In our specimens of *T. glaucus*, the dorsal formula is V, I, 19, the anal III, 17. The gill-rakers are short and thick at the base and taper rapidly to a point. They number 9 on the lower part of the arch, and in length are but one-third the diameter of the eye.

Measurements in Hundredths of Length without Caudal.

Species	TRACHINOTUS RHODOPUS			TRACHINOTUS GLAUCUS
Locality	*Panama*			*Key West*
Length without caudal in mm	227	221	232	226
Head	27	26½	27	26½
Greatest depth at angle of dorsal	51	54	49	53
Eye	6½	6½	6½	6½
Snout	6½	7	7	6½
Maxillary	9½	10	9½	9
Interorbital (bone)	9	9½	9½	9½
Pectoral fin	23	24	23	21½
Ventral fin	10	10½	11½	11½
Upper caudal lobe	50	53	51	Broken
Length of gill-rakers	3½	4	4	2¼
Height of caudal peduncle	8½	8½	9	9
Number of dorsal spines	VI, I	VI, I	VI, I	V, I
Number of dorsal rays	20	20	20	19
Number of anal spines and rays	III, 18	III, 19	III, 19	III, 17
Number of gill-rakers on lower limb of arch	15	15	14	9

152. Trachinotus culveri *Jordan & Starks.*

A single specimen was taken in the market.

This species seems to differ from *T. falcatus* in having a slightly shorter dorsal and anal. Our Panama specimen and the type and co-type from Mazatlan have the following fin counts: Dorsal VI, I, 18; VI, I, 18; VI, I, 17; anal III, 16; III, 17; III, 16. In twelve specimens of *T. falcatus*, three have 20 soft rays in the dorsal, nine have 19; in the anal, nine specimens have 18 soft rays, three have 17. As the largest specimen of *falcatus* in our possession is but 8 cm. in length, other comparisons are unsatisfactory.

T. culveri differs from *T. kennedyi* in having a deeper, more angulated body and in having the mouth more oblique. The anterior end of the premaxillary is on a level with a point a little above the lower rim of the orbit in *T. culveri*, while it is slightly below the orbit in *T. kennedyi*.

153. Trachinotus kennedyi *Steindachner.*

Frequently brought to market but never in large numbers. Six specimens were preserved, 28 to 31 cm. in length.

They are smaller than the specimens from which Dr. Steindachner wrote his excellent description, and differ slightly as follows: Head $3\frac{1}{6}$ to $3\frac{1}{2}$ in length; depth $1\frac{3}{4}$ to $1\frac{4}{5}$. Eye 4 to $4\frac{2}{3}$ in head; interorbital width $2\frac{1}{2}$. The maxillary reaches to below the middle of the eye or only slightly beyond that point.

154. Trachinotus paloma *Jordan & Starks.*

One adult specimen taken, 31 cm. in length. We have in addition a large specimen from Magdalena Bay and several small ones (including the types), from 5 to 10 cm. in length, from Mazatlan and San Juan Lagoon, Mexico. For comparison we have a single large specimen and two smaller ones of *T. carolinus* from the Atlantic.

T. paloma differs from *T. carolinus* in having a smaller eye, $5\frac{2}{3}$ to $5\frac{1}{2}$ in head in adult, $3\frac{4}{5}$ to $4\frac{1}{5}$ in young ($4\frac{4}{5}$ in *carolinus* in adult, 3 to $3\frac{1}{2}$ in young). The gill-rakers are longer, their length contained 6 times in the postorbital part of the head in the adult (10 times in the adult of *carolinus*). They number the same in the two species, 4 + 9 or 10. The snout is longer, $3\frac{1}{2}$ in head (4 in head in *carolinus*), and the maxillary is shorter, 3 in head ($2\frac{3}{4}$ in *carolinus*). The anal lobe seems to be shorter, $1\frac{1}{4}$ in head, $1\frac{4}{5}$ in anal base (in *carolinus* it equals head and is $1\frac{1}{2}$ in base of anal). We find little difference in size of head between the two species, though such was alleged to exist in the original description of *T. paloma*.

155. Nomeus gronovii (*Gmelin*).

Recorded from Panama by Dr. Eigenmann (1894, p. 629), who states that they were taken in "rocky pools at Panama." It has not been taken by other observers.

156. **Peprilus palometa** (*Jordan & Bollman*).

This species was frequently brought to the Panama market. As the type of the species was only 7 cm. in length, we supplement the original description by the following taken from specimens 19 to 23 cm. in entire length.

Head $3\frac{1}{3}$ to $3\frac{1}{2}$ in length without caudal; depth $1\frac{7}{10}$ to $1\frac{9}{10}$. Eye $4\frac{1}{3}$ to $4\frac{3}{4}$ in head; maxillary $3\frac{1}{2}$; dorsal III, 44 to 46; anal III, 41 to 43. Lateral line 100. Gill-rakers 5 + 16 or 17.

Body compressed and deep, the dorsal and ventral outlines similar in contour behind the head. Dorsal profile of head more convex than ventral; the snout blunt. Mouth small and oblique, the maxillary barely reaching past the anterior orbital rim. Teeth in a single row on jaws; none evident on vomer or palatines. Gill-rakers about half as long as the diameter of the eye.

A few scales present on head under and behind the eye, and a few at upper end of opercle; head otherwise naked. Scales on body smooth, crowded, and loosely attached; those of lateral line more firmly attached. Dorsal, anal, and caudal fins covered with fine crowded scales.

In the co-types, with which we have compared our specimens, no lobes are evident on the dorsal and anal fins. In the adult specimens, the lobes are well developed, though variable in length; they are generally longer in the larger specimens. The spines of dorsal and anal are scaled over, as are the rays. Anal lobe much longer than that of dorsal, often reaching to below the tips of the last anal rays, or to base of caudal fin. Dorsal lobe sometimes extending to opposite tip of pectoral, sometimes reaching further back. Dorsal and anal rays behind the lobes of about equal height, generally a little higher than the diameter of eye, though often less than that in the smaller specimens. Tip of pectoral generally reaching to half way between its base and tips of middle caudal rays. Pelvic bones ending as a short sharp spine. Upper lobe of caudal the longer, sometimes filamentous.

Color bluish brown on back, silvery on lower parts of body. Top of head and snout colored like the back. Opercle with dusky brown areas. Dorsal, anal and caudal variously dusky. Pectoral dusky behind base; the rays sparsely covered towards their ends with rather large brown dots.

Measurements in Hundredths of Length without Caudal.

	Co-types Panama Bay			Panama Market									
Length without caudal in mm	50	57	58	132	135	136	136	156	168	168	170	174	175
Head	36	37	37	32	30½	31	30	29	29½	27½	28½	29	29
Depth	48	50	50	54	52	53	53	56	56	51	53	53	56½
Eye	10½	10½	10½	7½	7½	7½	7½	6¾	6½	6½	6¼	6¼	6½
Snout	8	7½	7½	7½	7½	7½	7½	7	7	7¼	7	7	6¾
Maxillary	11	11	11	9	8½	9	8½	8	8	8	8	8	8
Dorsal lobe from base of third ray	Broken	....	....	29	35	31	31	Broken	30	35	32	29	Broken
Anal lobe from base of third ray	No lobes are evident			46	52	43	50	49	53	60	51	Broken	58
Length of pectoral	33	31	Broken	39½	41½	43	41	43	43	40	40½	39	42
Upper lobe of caudal	Caudal broken		....	40	48	45	Broken	Broken	39	59	48	42	45
Scales in lateral line*	100	98	98	95	100	101	103	98	100	95	100	99	97
Number of dorsal rays	III, 45	III, 46	III, 44	III, 46	III, 45	III, 44	III, 45	III, 46	III, 45	III, 44	III, 46	III, 45	III, 45
Number of anal rays	III, 43	III, 43	III, 43	III, 42	III, 43	III, 42	III, 43	III, 42	III, 41	III, 42	III, 42	III, 41	III, 42
Gill-rakers	5+16	5+17	5+16	5+16	5+16	5+16	5+16	5+16	5+17	5+17	5+15	5+16	5+15

---

*Scale counts cannot be very accurate, as many of the specimens have scales missing.

157. Peprilus snyderi sp. nov.

PLATE XII, FIG. 23.

Head $3\frac{1}{2}$ in length without caudal; depth $2\frac{3}{5}$. Eye $5\frac{3}{5}$ in head; snout $3\frac{1}{3}$; maxillary $3\frac{7}{8}$. Scales 110. Dorsal III, 45; anal III, 43. Gill-rakers 5 + 16.

Dorsal and ventral outlines of body similar, the body not greatly compressed, more elongate than in any other American species. Snout blunt. The occipital crest forms a sharp ridge on top of head. Mouth rather small, the maxillary barely reaching to the vertical from anterior edge of eye; jaws subequal. Teeth small and close-set in a single even series, those of lower jaw fitting inside those of upper jaw when mouth is closed. Gill-rakers moderately slender, half as long as the diameter of the eye, their number 4 or 5 + 14 to 16. Top of head with a network of sensory canals ramifying over it, the most conspicuous branch vein-like above anterior part of eye. Branching canals also extend more or less over the scales of back above lateral line, sometimes reaching nearly to dorsal spines.

Head entirely scaleless except the cheeks and upper part of opercles. Dorsal, anal and caudal with very small, crowded scales, extending nearly to the ends of the rays. Pectoral scaleless. Body completely invested with rather loosely attached scales.

Dorsal and anal fins with moderate lobes, that of anal slightly longer than that of dorsal, about equal to the length of head without snout. Base of anal a little shorter than that of dorsal. Tip of pectoral nearly reaching to the vertical above notch behind anal lobe, its length greater than that of the head by the diameter of the eye. Pelvic girdle ending as a small sharp spine. Caudal longer than pectoral by nearly half eye.

Color bluish brown on back, changing to a warm Vandyke brown on naked parts of head. Caudal a rich dark brown similar to that of head. Pectoral brown at base, toward end of rays dusky, with dark points. Other fins dusky. One specimen is more silvery than the others, and may represent more nearly the original coloration. Top of head brown. Caudal, dorsal and anal slightly dusky.

The type is 255 mm. in entire length. The species came to market on but two days of our visit of six weeks. Seven specimens in all were seen and preserved.

The species is named for our friend and associate, Professor John O. Snyder, who has helped us materially in the preparation of this report.

Measurements in Hundredths of Length without Caudal.

	Type						
Length without caudal in mm.	200	215	211	187	180	187	192
Head	28½	28	27	28	29	28	28½
Depth	37	38	37½	39	41	37½	39
Eye	5½	5½	5½	5½	5½	5½	5½
Snout	7½	7½	7½	8	8	7½	7½
Maxillary	8	7½	8	8½	8½	8	8½
Longest dorsal rays	19½	19½	19	22	21½	20	22
Longest anal rays	20	21	20	24	23	21	23
Length of pectoral	32	32	31	33	32½	32	33
Length of caudal	34	34	33	36	34	35	35
Number of scales	107	112	106	....	111	108	109
Number of dorsal rays	III, 45	III, 45	III, 43	III, 44	III, 44	III, 45	III, 44
Number of anal rays	III, 43	III, 42	III, 43	III, 42	III, 42	III, 43	III, 42
Number of gill-rakers	5+16	4+14	4+16	4+16	4+14	4+15	4+14

158. **Peprilus medius** (*Peters*).

The Panama record of this species (Jordan, 1885, p. 375) needs verification. The specimens obtained may have belonged to one of the forms above recorded, both of which were at that time unknown. Only the type of *P. medius* is now extant.

Family CHEILODIPTERIDÆ.

159. **Apogon dovii** *Günther.*

Abundant about the rocky islands in Panama Bay.

The species varies in color from light to dark red, with much or little black pigment. The caudal may be translucent or blackish, the soft dorsal is translucent, or may be tipped with black, or may be largely black with only the posterior rays whitish. The anal and ventral fins may also be translucent, or with the terminal portions more or less largely black. Young specimens are marked with a very conspicuous round or elliptical black spot on the end of the caudal peduncle, and a rather poorly-defined dusky streak around the snout and across the opercle. The streak wholly disappears and the caudal spot becomes very faint and diffuse with age.

There seem to be no differences, save those of color, between *A. dovii* and *A. retrosella*. The fin-rays, general proportions, and squamation seem alike in the two. The fin-formula is: dorsal VI I, 9; anal II, 8. The lateral line traverses 24 or 25 large scales to the base of the caudal fin, and 5 or 6 scales of reduced size on the fin itself. Between the lateral line and the base of the spinous dorsal are 2½ rows of scales (as in *retrosella*). In *A. atricaudus* there are 4½ or 5½ rows, in *A. atridorsalis* 3½ rows between the lateral line and the spinous dorsal.

Measurements in Hundredths of Length without Caudal.

Species	APOGON DOVII			A. RETROSELLA	
Locality	Panama			Mazatlan, Mex.	San Benito Id., Mex.
Length without caudal in mm.	70	62	60	76	55
Head	40	41	40	40	42
Depth	35	34½	34	34	34
Eye	12	13	12½	13	12
Interorbital (bone)	9	9	8½	8½	9
Snout	10	10	9½	9	9
Maxillary	21	21	20½	21	21
Third dorsal spine	15½	15½	17	17	17
Second dorsal ray	22	23	24	25	24
Second anal spine	9½	10	11½	12½	12½
Second anal ray	21	20	20	21	21
Pectoral	24	24	25	25	24
Ventral	20	19	20½	22	20
Caudal	29	29	28	28	29

Family CENTROPOMIDÆ.

160. Centropomus undecimalis (*Bloch*).

Frequently found in the Panama market.

We are unable to follow Dr. Jordan (1895 *b*, p. 452) in recognizing the Pacific form as a distinct species (*C. viridis*). The separation is based on the supposed greater length of the appendages to the air-bladder in *viridis*, and the shorter second anal spine. We find, however, that the third anal spine projects beyond the second in Atlantic specimens as well as in those from the Pacific, and there seems to be no difference between them in this respect. The appendages to the air-bladder vary widely in length, from a trifle less than the diameter of the eye to twice the diameter, in our Panama specimens. In the few individuals we have been able to examine from the Atlantic (Havana and Jamaica), the appendages vary from $1\frac{1}{5}$ to $1\frac{1}{2}$ times the orbital diameter. It is highly improbable, therefore, that this character possesses any significance.

161. Centropomus nigrescens *Günther.*

Only a few small specimens seen.

162. Centropomus pedimacula *Poey.*

Very abundant at Panama.

We have had for comparison a single specimen from the Atlantic, which shows a slightly longer anal spine and a slightly wider interorbital space than any of our Pacific examples. In all other characters there seems to be perfect agreement with our Panama specimens. We believe that the slight differences found are well within the range of variation of the species, and shall therefore not recognize *Centropomus medius* (the Pacific form) as distinct in any degree. A full series from the Atlantic may eventually prove, however, that these characters have a higher value than we have assigned to them, and necessitate specific separation of the two forms.

C. grandoculatus is certainly not separable from *C. medius* (=*pedimacula*). The scale-counts of different authors vary widely in this group, as some have included a number of the scales overlying the base of the caudal fin, and others cease the enumeration at a point corresponding to the base of the median rays. In this paper we have adopted the latter course, and find very uniformly 47 or 48 tubes in specimens from Mazatlan, Panama and Havana, including those from the San Juan Lagoon, Mexico, upon which is based the description of *grandoculatus* given by Jordan and Evermann. The first dorsal fin contains uniformly 8 spines, as in all other species of the genus. The describers of *grandoculatus* seem to have neglected the first spine, which is very short and often concealed by the scales. Other characters assigned to *grandoculatus*, such as the form of the body and the size of the eye, have no significance. The amount of black on the ventral fins is also subject to wide variation, and has no distinctive value. In young specimens, the black is usually very distinct, but in adults it grows fainter and often disappears.

163. Centropomus unionensis *Bocourt.*

PLATE XIII, FIG. 27.

Abundant in Panama Bay.

The species is closely related to *armatus* and *robalito*, but has shorter anal spines and weaker ridges and spines on head than in either species. It agrees with *robalito* in the slender, flexible dorsal spines, the second one of which is very short, in the anterior position of the vent and in the pale lateral line; with *armatus* in the small number of gill-rakers, and the increased number of scales in a vertical series above the lateral line. The second anal spine scarcely extends beyond the tip of the longest anal ray, and extends beyond the third anal spine a distance less than half the diameter of the pupil. The interspinous membrane is not dusky. The dorsal spines are slenderer even than in *robalito;* the third is not heavier than the fourth, and is usually shortened a little, giving a rounded contour to the fin, which is sometimes, however, sharply angular. The second dorsal spine is very short, varying from one-fourth to one-sixth the length of the third. The distance from the vent to the base of the first anal spine equals that between the tip of the snout and some point between the hinder margin of the pupil and the hinder margin of the orbit. The preorbital and the horizontal and vertical limbs of the preopercle are very weakly spinous, the spines being scarcely perceptible in some specimens. There are 2 stronger spines, as usual, at the preopercular angle. The ridges on top of head are low and narrow; the median pair are most widely separated at a point over the middle of the occiput. There are 5 or 6 developed gill-rakers on the vertical limb of the outer arch, 11 or 12 on the horizontal limb, besides 2 or 3 rudiments on each. There are 47 or 48 scales in the lateral line in advance of the base of the caudal, and 7½ in a vertical series between the middle of the soft dorsal and the lateral line. The lateral line is uniformly pale.

Measurements in Hundredths of Length without Caudal.

Length in mm. without projecting lower jaw or caudal...	254	251	244	255	239	250
Head without lower jaw	41	40	39½			
Depth	28	28	28			
Eye	5¼	5	5			
Interorbital (bone only)	5¾	6	5½			
Maxillary	14	13½	14			
Third dorsal spine	17½	17½	18			
Fourth dorsal spine	17	17½	17½			
Fifth dorsal spine	14½	14½	14			
Second anal spine	18½	19	18			
First anal ray	15½	16	16			
Second dorsal ray	broken	15½	15			
Pectoral	23½	24½	23½			
Ventral	21½	21	21½			
Caudal	broken	about	24			
Caudal peduncle (height)	11½	12	11			
Vent from front of anal	16	14½	15	14½	15½	14½
Distance from anal to base of ventral spine	38	38½	39			
Longest gill-rakers	4	3½	4			

164. Centropomus armatus *Gill.*

PLATE XIII, FIG. 26.

Abundant in Panama Bay; distinguishable at sight by the excessively developed second anal spine with the black interspinous membrane, and by the strong, inflexible dorsal spines.

The species is placed by Boulenger (1895, p. 370), in the synonomy of *C. ensiferus*, but this is wholly inadmissible, as has been pointed out by Jordan and Evermann (1896, p. 1123).

C. ensiferus agrees with *armatus* in the strongly spinous bones of the head, and in its greatly developed second anal spine and black membrane; but it differs conspicuously in the slender, flexible dorsal spines, and in the course of the cranial ridges and the shape of the included areas. In the three specimens of *ensiferus* before us from the Atlantic, there are but 5 or 6 scales in a vertical series between lateral line and middle of second dorsal fin. The gill-rakers in these specimens are as follows: 9+17, with 3 additional rudiments on each limb; 9+17 with 4 rudiments above, 5 below; 8+16, with 4 rudiments on each limb. The distance from the middle of the vent to the base of the first anal spine equals, or a little exceeds, that from tip of snout to hinder edge of pupil. The second anal spine extends to opposite the edge of the scaly area on base of caudal, and is contained $3\frac{9}{10}$ to $3\frac{5}{6}$ times in the length. The character and direction of the ridges on top of head are very characteristic, and are well shown by the accompanying figure (Pl. XIII, fig. 24).

In *C. armatus*, the second anal spine is longer than in any other Pacific species, to be compared in this respect with *C. ensiferus* only. The fifteen specimens secured by us vary little in the length of this spine, which extends, when depressed, to opposite the base of the caudal in young specimens, well beyond that point in adults. The third anal spine usually exceeds slightly the longest soft ray. The membrane between the second and third anal spines is jet-black in the young, and is usually blackish in varying degree in adults. In none of our specimens has the pigment entirely disappeared, but it is not improbable that it occasionally does so. The dorsal spines are much stronger than in any other known species, and are wholly constant in this regard. The third spine is the strongest, and is inflexible; it is but little longer than the fourth, which projects beyond a line joining the third and fifth, giving a rounded contour to the fin. There is considerable variation in the height of the spines, the fourth spine, when depressed, reaching occasionally to or beyond the origin of the second dorsal, but usually falling short. The second spine is proportionally long, $2\frac{1}{2}$ to $3\frac{1}{4}$ in the third spine. The dorsal formula is VIII–I, 10 (11 articulated rays in one specimen); the anal III, 6. The vent is posteriorly placed, the distance from its center to the base of the first anal spine about equaling the distance from the tip of the snout to the middle of the eye. The preorbital has 5 to 7 strong retrorse spines; an equal number of still stronger spines are in the "humeral" process; preopercular spines much larger than in *robalito* or *unionensis*.

The median pair of ridges on top of head are very strong. From the middle of the occiput they diverge a little, both anteriorly and posteriorly, and are separated at their posterior ends by a distance equaling the diameter of the pupil; anteriorly they converge, meeting at a point opposite the front of the eye.

The gill-rakers are long and slender, the longest two-thirds to five-sevenths the diameter of the eye, there being 5 or 6 movable ones on the vertical limb, and 11 or 12 on the horizontal limb, besides 2 or 3 immovable rudiments on each limb. There are 51 or 52 tube-bearing scales in the course of the lateral line, corresponding in number with the approximately vertical series along the back. Each vertical row under the middle of the second dorsal fin contains 7½ or 8½ scales in the fifteen specimens examined. The lateral line is pale, but is accompanied above and below by short stitch-like lines of black pigment, one pair for each scale.

Measurements in Hundredths of Length without Caudal.

Length in mm. from tip of snout to caudal base..	207	222	230
Head without lower jaw	39½	40	39
Depth	27	29	27½
Eye	6	6	5½
Interorbital (bone only)	5½	5½	5½
Maxillary	14	14	14½
Third dorsal spine	17½	17½	17
Fourth dorsal spine....	17½	18½	16½
Fifth dorsal spine......................................	15	15½	14½
Second anal spine	27½	27	27
First anal ray	18	18	18
Second dorsal ray	17½	18	17
Pectorals	26	27	27
Ventrals	23½	23	22
Caudal..	26	25	25
Caudal peduncle (height)..........................	11½	12	11½
Vent from front of anal..............................	12½	12½	14
Distance from anal to base of ventral spine......	39	36	37½
Longest gill-rakers	4½	4½	4½

165. Centropomus robalito *Jordan & Gilbert.*

PLATE XIII, FIG. 25.

Very abundant at Panama.

Dr. Boulenger places this species in the synonomy of *C. ensiferus*, and Jordan and Evermann consider the two probably identical. They are easily distinguishable, however, by the different size and the direction of the ridges on the top of the head, by the larger serrations in *C. ensiferus*, the longer anal spines, and the rounded contour of the spinous dorsal. The membrane between second and third anal spines seems to be constantly blackish in *ensiferus*, and is usually pale in *robalito*. From *C. armatus*, *robalito* differs strikingly in the longer, more flexible, dorsal spines, the angular contour of the spinous dorsal fin, the ridges on head with the shape of the enclosed areas, the shorter anal spines with the light interspinous membrane, the more anterior position of the vent, the more numerous gill-rakers, the larger scales, and the uniformly light color of the lateral line. The third anal spine fails to attain the tip of the succeeding soft ray. The second spine extends beyond the third for a distance equaling one-half to three-fourths the diameter of the eye; it sometimes attains the base of the caudal fin, but more frequently fails to do so. The dorsal spines are long and flexible, the third little heavier than the fourth. The fin is sharply angulated at the tip of the third spine, which usually reaches a straight line joining the tips of the succeeding spines. The second spine is very short, contained 4 to 4½ times in the third. The distance from the vent to the base of the first anal spine nearly equals that from tip of snout to hinder margin of orbit, varying a little from that measurement in either direction. The spines on the margin of the preorbital and preopercle are distinct and strong, but less so than in *armatus*.

The median pair of ridges on head are stronger than in any other species, and enclose a narrower space, which is widest opposite the posterior ends of the ridges and is regularly wedge-shaped, the ridges meeting at a point opposite the nostrils. The gill-rakers are long and slender, the longest two-thirds the diameter of the orbit. They are more numerous than in *armatus*, 7 or 8 movable ones on the vertical limb and 15 or 16 on the horizontal limb, with 2 or 3 rudiments at each end of the series. There are 46 to 49 scales in the lateral line in advance of the base of the caudal fin, and 5 or 6 scales in a vertical series between the lateral line and the middle of the second dorsal. The lateral line is uniformly pale.

In the fresh state the ventrals are rich golden yellow, whitish at the base, with white pigment at tips, best marked on the inner rays. Anal lemon-yellow, including the membrane between the spines, which is rarely dusky; the base of the fin and the last two rays are translucent. The spinous dorsal is translucent dusky, not distinctly black; the soft dorsal similar, translucent at base. The caudal is dusky translucent, slightly tinged with straw color, the latter best marked on the lower lobe. The pectorals are translucent.

Measurements in Hundredths of Length without Caudal.

Length in mm. without projecting lower jaw or caudal	192	261	250	240	242	222	242
Head without lower jaw	40	$39\frac{1}{2}$	$39\frac{1}{2}$				
Depth	$27\frac{1}{2}$	28	27				
Eye	$6\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$				
Interorbital (bone only)	$4\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{1}{2}$				
Maxillary	$13\frac{1}{2}$	14	$13\frac{1}{2}$				
Third dorsal spine	19	18	18				
Fourth dorsal spine	18	$15\frac{1}{2}$	$16\frac{1}{2}$				
Fifth dorsal spine	15	13	14				
Second anal spine	24	20	20				
First anal ray	$17\frac{1}{2}$	16	16				
Second dorsal ray	$18\frac{1}{2}$	17	18				
Pectoral	$25\frac{1}{2}$	24	25				
Ventral	$23\frac{1}{2}$	22	$23\frac{1}{2}$				
Caudal	$27\frac{1}{2}$	....	25				
Caudal peduncle (height)	$12\frac{1}{2}$	$12\frac{1}{4}$	12				
Vent from front of anal	$15\frac{1}{2}$	$16\frac{1}{2}$	16	16	$16\frac{1}{2}$	$17\frac{1}{2}$	17
Distance from anal to base of ventral spine	39	40	41				
Longest gill-rakers	5	$4\frac{1}{4}$	$4\frac{1}{2}$				

Family SERRANIDÆ.

166. **Petrometopon panamensis** (*Steindachner*).

This species is seldom brought to the market, though it is very abundant about the islands in Panama Bay.

The excavation in the frontal bones for the reception of the posterior processes of the premaxillaries is not so deep as in *P. guttatus*. It more nearly resembles in this respect *Epinephelus louti*, as figured by Boulenger (1895, p. 173).

To the type description we add the following range of measurements, taken from specimens 19 to 28 cm. in length: Head $2\frac{3}{5}$ to $2\frac{2}{3}$ in length, without caudal. Eye $5\frac{1}{4}$ to 6 in head; interorbital width (bone) $9\frac{1}{2}$; snout $3\frac{3}{4}$ to 4. The fin formula seems to be constant as described: Dorsal IX, 14; anal III, 8. The small canines anteriorly in each jaw are sometimes paired on one or both sides.

167. Epinephelus analogus *Gill*.

Abundant among the islands in Panama Bay, brought to market in considerable numbers.

No variation has been reported in the number of dorsal spines, which seems to be constantly ten. In a specimen 20 cm. long, the upper parts were dusky-olive, the under parts lighter, the cross-bars very faint. The spots were brownish-red. The dorsal and the upper caudal rays were colored like the back; the fins otherwise were slaty-blue with a whitish margin, all of them spotted like the soft dorsal. In specimens 8 to 10 cm. long, the dark bars are distinctly six in number, one on the nape, two below the spinous and two below the soft dorsal, and one on the tail. They are well marked above the lateral line, but fade out on lower part of sides. The round dark spots are confined to the bands, where they are arranged in pairs, forming two vertical series in each band; the two middle bands contain five pairs each.

168. Epinephelus labriformis (*Jenyns*).

Abundant in the Panama market.

In our smallest specimens, 6 and 15 cm. long, there is no trace of the numerous gently undulating pale lines running upward and backward, described by Steindachner (1876, *b*, p. 5) in a specimen 75 mm. long. In none of our specimens was the inside of mouth salmon-yellow, as described by Jordan (1895, *b*, p. 444); the lips were faintly tinged with yellow. The distal half of the upper pectoral rays was deep red, shading below into the yellow of the lower rays. The black saddle on caudal peduncle seems to be constantly present. The number of articulated dorsal rays is constantly 17, as given by Jenyns and Gill.

169. Promicrops guttatus (*Linnæus*).

Very large specimens are frequently brought to market.

170. Alphestes multiguttatus (*Günther*).

Abundant in Panama Bay, the young very numerous in the tide-pools. The young have fewer spots, mostly confined to the head, while the sides of the body are marked by wavy longitudinal dusky streaks, which are much darker where they traverse certain vertical areas, thus producing a number of vertical bars, which soon disappear. The dark streak behind the maxillary is more conspicuous than in adults. In specimens less than 35 mm. long, the preopercular angle is provided with a large furcate spine, with a long posterior and a short anterior limb. The posterior limb rapidly diminishes in size, while the anterior limb elongates and becomes appressed to the preopercular margin, forming the antrorse spine characteristic of the genus.

As has been pointed out, this species is well distinguished from *A. afer*, by differences in color and in the contour of the head and body. We find no difference, however, in the relative lengths of the second and third anal spines, and very little difference in the length of the gill-rakers. *A. multiguttatus* has the gill-rakers a trifle longer than in *A. afer*, but they do not exceed two-thirds the length of the gill-filaments.

171. **Mycteroperca boulengeri** *Jordan & Starks.*

Probably rare; only two specimens taken, each about 23 cm. in length.

We make the following corrections to the original description, and to the description given by Jordan and Evermann (1896, p. 1175):

Head $2\frac{2}{3}$ in length ($2\frac{7}{8}$ in type, 30 cm. long); depth $3\frac{1}{3}$ ($2\frac{9}{10}$ in type). In our specimen, and in the type and co-types (3 specimens) from Mazatlan, the dorsal is constantly XI, 16, the anal III, 11. Scales 23–90–44; ctenoid posteriorly, becoming cycloid anteriorly. Snout 4 in head; eye $5\frac{1}{2}$ ($6\frac{1}{5}$ in type); longest anal ray 2 ($1\frac{1}{5}$ in type); third dorsal spine 3.

172. **Hypoplectrus lamprurus** (*Jordan & Gilbert*).

Only the type is known, obtained by Gilbert in 1881, at Panama.

173. **Paralabrax humeralis** (*Cuvier & Valenciennes*).

Young specimens of this species are recorded from Panama by Steindachner (1876, *b*, p. 4) as *Serranus albomaculatus.*

174. **Diplectrum radiale** (*Quoy & Gaimard*).

Occasional in the Panama market, not taken by us about rocky reefs or islands. There are constantly 10 series of scales on the cheeks running obliquely downward and forward; $5\frac{1}{2}$ to 6 scales in a series between lateral line and base of dorsal near the middle of the length; and seven articulated rays in the anal fin. There is but little variation in the size and spination of the preopercular lobe, the species being readily distinguishable from *D. macropoma* and *D. euryplectrum* by this character alone.

175. **Diplectrum macropoma** (*Günther*).

No specimens of this species were secured by us. It seems to occur abundantly a short distance from the shore, where it was dredged by the "Albatross" in depths of from 7 to 33 fathoms. A single specimen was said to be found by them in the Panama market. Its range seems to be co-extensive with that of the tropical fish-fauna in general, as it was obtained by the "Albatross" in 1889 at Station 3014, off Guaymas, Gulf of California, 29 fathoms, and at Station 3039, off Magdalena Bay, Lower California, 47 fathoms.

The species is very close to *D. radiale*, but differs constantly in the wider preopercular lobe, the larger scales on cheeks (6 or 7 rows), and the larger head and deeper body. There are constantly 7 anal rays. The colors in life have not been recorded; but there are no distinct blue spots on the dorsal, in our material, and in general the coloration seems to have been less variegated than in *D. radiale*.

176. Diplectrum euryplectrum *Jordan & Bollman.*

Known only from moderate depths in Panama Bay, where it was dredged by the "Albatross" in 1888, in 33 to 51½ fathoms.

It is a deeper species than *radiale*, with much wider preopercular lobe, 8 series of scales on the cheeks, and constantly 8 anal rays. There is no trace of blue spots on the soft dorsal, which is marked by a very characteristic narrow black bar along the base. The coloration in the fresh state has not been reported. Judging from alcoholic specimens, it is probable that the species differs widely from *radiale* in that respect. It was not taken in the Gulf of California with its companion species, *D. macropoma*.

177. Prionodes fasciatus *Jenyns.*

This species is abundant among the Galapagos Islands, and on the coast of Mexico, but has been recorded but once from Panama Bay (Pearl Islands and Panama, Jordan & Gilbert, 1882, *n*, p. 625). It was not seen by us.

178. Paranthias furcifer (*Cuvier & Valenciennes*).

Not seen by us; recorded from Panama by Steindachner (1876, *b*, p. 6; as *Serranus creolus*), and by Gilbert (see Jordan, 1885, p. 377).

Rhegma *Gilbert.*

Rhegma GILBERT (JORDAN & EVERMANN, 1898, p. 3169).

Allied to *Rypticus*, *Grammistes* and *Gramma*, having the large ctenoid scales and interrupted lateral line of *Gramma*, and the peculiar physiognomy, attachment of gill-membranes, and fin structure of the *Rypticinæ*.

Scales of moderate size, thin, not embedded, minutely ciliated; lateral lines 2, the upper near base of dorsal, ceasing under origin of posterior fifth of soft dorsal, the lower line beginning slightly in front of the end of the upper line, running along middle of caudal peduncle; the tubes very short, borne on much smaller intercalated scales, and not forming a continuous line. Head largely scaled, the snout and jaws naked.

Gill-membranes united anteriorly, forming a narrow free fold across the isthmus. Branchiostegals 7. Pseudobranchiæ well developed; a wide slit behind last gill-arch; gill-rakers short, broadly triangular, strongly toothed. Upper margin of opercle, above its angle, wholly attached by membrane to the shoulder girdle, as in the *Rypticinæ*. Mouth large, protractile, the lower jaw protruding, the maxillary broadly exposed, with a narrow supplemental bone along its upper edge. Teeth all villiform, in broad bands on jaws, vomer and palatines, the inner teeth on jaws slightly longer than the others and depressible. Tongue smooth. Large mucous pores on under side of mandible, and slit-like pores present on edge of preorbital and around front of eye. Anterior nostril near edge of preorbital, provided with a short tube; posterior nostril without tube or raised rim, immediately in front of eye. A short free triangular flap on upper edge of each orbit. Upper portion of preopercle with a single strong plectroid spine, directed backward and downward; bones of the head otherwise unarmed, the preorbital and preopercle with entire edges, the opercle without spines or ridges.

Ventrals small and anterior in position, as in the *Rypticinæ*, consisting each of 1 strong spine, and 5 branched rays, their base being in front of base of pectorals; no enlarged scale behind base of ventrals. Vertical fins low, with rounded lobes, their basal portions well scaled; dorsal with 7 low strong spines and 22 profusely branched rays; anal with 3 spines and 18 rays. One species, apparently the type of a distinct sub-family, *Rhegmatinæ*.

179. Rhegma thaumasium *Gilbert.*

PLATE XV, FIG. 31.

Rhegma thaumasium GILBERT, l.c., p. 3170.

Head $2\frac{4}{5}$ in length; depth 3; eye 5 in head; D. VII, 22; A. III, 18. Scales 45 in a longitudinal series along middle of side.

Body elongate, moderately compressed, with very short, deep, caudal peduncle. Anterior profile strongly arched, slightly depressed above orbits. Interorbital space very narrow, convex, its width two-thirds diameter of orbit. Mouth large, slightly oblique; lower jaw the longer, its tip entering the profile.

Dorsal spines low, strong, increasing backward, the last spine one-fourth longer than diameter of orbit. Anal spines short and strong, the middle spine longest.

Lateral line curved strongly upward from its origin to below third dorsal spine; thence running parallel with the back to below middle of second dorsal, from which point it gradually approaches the base of the dorsal, where it terminates under the fifth ray from the last; along its anterior course it is separated from base of dorsal by from 4 to 6 scales (in oblique series). Scales minutely ctenoid except on head, breast, and belly, on nape under anterior dorsal spines, and on base of pectoral. Top of head scaled forward to interorbital space, the anterior scales here, as well as those on cheek, much reduced in size, embedded, so that their outlines cannot be distinguished.

The following measurements of the type specimen are given:

	mm.	One-hundredths of length to base of caudal.
Total length	85	
Length to base of caudal	70	
Greatest depth		33
Least depth of caudal peduncle		$15\frac{1}{2}$
Length of caudal peduncle		8
Distance from tip of upper jaw to end of opercular flap		37
Length of snout		6
Diameter of eye		$7\frac{1}{2}$
Interorbital width		$3\frac{3}{4}$
Tip of snout to end of maxillary		19
Length of pectoral		27
Tip of snout to base of upper pectoral ray		35
Tip of snout to base of ventrals		31
Length of ventrals		13
First anal spine		$3\frac{1}{2}$
Second anal spine		6
Third anal spine		$4\frac{1}{2}$
First soft anal ray		$8\frac{1}{2}$
Longest soft anal ray		15
First dorsal spine		4
Last dorsal spine		9
Longest dorsal ray		15
Caudal		23

Color, nearly uniform warm brown on head, body and fins; a dusky opercular blotch; soft dorsal, anal and caudal only narrowly margined with white.

One specimen known, from Panama.

180. **Rypticus nigripinnis** *Gill.*

Not rare. The upper preopercular spine is minute, but seems to be constantly present. The second dorsal spine is usually a little longer than the first, and is united for its entire length by membrane with the succeeding soft ray.

Family LOBOTIDÆ.

181. **Lobotes pacificus** *Gilbert.*

PLATE XIV, FIG. 28.

Lobotes pacificus GILBERT, (JORDAN & EVERMANN, 1898, p. 2857).
Lobotes auctorum STEINDACHNER, 1876 *b*, p. 6; Panama. Not of Günther.
Lobotes surinamensis JORDAN & GILBERT, 1882 *d*, p. 110; Panama. GILBERT, 1882, p. 112; Punta Arenas. JORDAN, 1885, p. 378; Panama. BOULENGER, 1899, p. 2; Rio Tuyra, Darien.

The *Lobotes* of the Pacific Coast of Central America is distinguished from the other known species, *L. surinamensis* and *L. erate*, by the small size of the preopercular serrations, those at the angle not elongated and spine-like, even in the young.

Head $2\frac{3}{4}$ in length; depth $2\frac{1}{5}$ to $2\frac{1}{10}$ (to base of caudal rays); depth of caudal peduncle $2\frac{1}{2}$ in head. Dorsal XII, 15; anal III, 11; pectoral 15. Scales 46 (+ 6 on base of caudal) $\frac{11}{18}$; vertebræ 12 + 12. Body more elongated than *L. surinamensis*, agreeing in this respect with *L. erate*, the depth less than half the length. Upper profile deeply concave at occiput, thence strongly convex to front of dorsal. Head shorter and narrower than in *L. surinamensis*, the interorbital width but slightly longer than snout, $3\frac{9}{10}$ to 4 in head ($3\frac{1}{3}$ to $3\frac{3}{5}$ in head in *L. surinamensis*). Eye small, $6\frac{2}{3}$ to $7\frac{1}{3}$ in head, 2 or $2\frac{1}{10}$ in interorbital width. Mandible strongly protruding, but without symphyseal knob. Maxillary narrow, not concealed in closed mouth, its tip reaching vertical from middle of pupil, $2\frac{6}{7}$ to $2\frac{9}{10}$ in head.

Upper jaw with a moderate villiform band of teeth, in front of which is a single series of conical close-set canines. Lower jaw with a single series, similar to outer series of upper jaw, and behind them a very narrow band of villiform teeth which grow slightly larger towards symphysis. Palate toothless.

Posterior margin of preopercle vertical, the angle protruding little or not at all. In five young specimens, 175 to 275 mm. long, the preopercular teeth are fine, acute, short and inconspicuous, about as in species of *Pomadasys*. They increase but little in size towards the angle, where they are never spine-like; below, they are perceptible only in the immediate vicinity of the angle, the remainder of the horizontal limb being entire. In the adult the vertical limb is finely and evenly toothed, the angle and lower limb slightly roughened or entire. Opercle with two short spinous points, behind the lower of which a narrow tongue-shaped process of the subopercle extends to near the edge of opercular membrane. The humeral process is very weakly toothed, contrasting with the strongly serrate condition in *L. surinamensis*. Branchiostegals 6.

Gill-rakers short, two-fifths diameter of eye in young, comparatively shorter in adults, 5 on vertical limb, all but one of which are broad firmly fixed tubercles, 14 on horizontal limb, the anterior two or three tubercular.

Spinous dorsal low, with gently rounded outline. Notch between dorsals shallow, the eleventh spine two-thirds the length of the longest, which is contained 2 to $2\frac{1}{3}$ times in head in the young, 3 times in adults. When declined, the spines are partially received within a scaly groove. Soft dorsal, anal and caudal with basal portions densely scaled, and with series of scales running up on membrane to beyond middle of fin. Soft dorsal and anal of equal height, forming bluntly rounded lobes, the longest rays of which are about half head in adults, $1\frac{1}{2}$ to $1\frac{3}{4}$ in head in young. Third anal spine about half length of longest ray. Pectorals shorter than ventrals, 2 to $2\frac{1}{3}$ in head; ventrals $1\frac{1}{2}$ in head in young, shorter in adults.

Scales less strongly ctenoid than in *L. surinamensis*. Tubes of lateral line mostly simple, occasionally with one to three branches.

Color grayish or brownish, with plumbeous or silvery reflections. The youngest specimens show faintly the dark streaks so conspicuous in young of *L. surinamensis*, viz: a pair running backwards from interorbital space; a pair from upper posterior border of eye converging towards front of dorsal; a broader band from eye downwards and backwards across cheeks. Soft dorsal, anal and caudal uniform blackish, or the caudal with an ill-defined lighter edge. Pectorals translucent; ventrals blackish.

Abundant at Panama, where it is known as *Berrugate*.

Family PRIACANTHIDÆ.

182. **Pseudopriacanthus serrula** (*Gilbert*).

Only the type known, from Albatross Station 2797, Panama Bay, 33 fathoms (Gilbert, 1890 *b*, p. 450).

Family LUTIANIDÆ.

183. **Hoplopagrus guentheri** *Gill*.

This species had not been taken previously farther south than Mazatlan. We secured one large specimen with dynamite among the rocky islands in the Bay. It must be very rare at Panama.

Lutianus.

The characters relied upon to separate *Neomænis*, *Lutianus*, *Genyoroge* and *Evoplites*, seem wholly lacking in distinctive value. The band of temporal scales may be narrow or wide, and may be isolated or may be surrounded by bands of smaller scales. All degrees of scaling of top of head are found among the Asiatic species, and considerable variation among the American members of the group. The temporal ridge never joins the orbital rim, but terminates at varying distances between that and the median crest. Its approximation to the median crest depends in part upon its production anteriorly, and this is in many species a question of age. No groups can be separated by this character, nor can the natural affinities of the species be determined by its aid. A third character is derived from the emargination of the preopercle, into which may fit a knob of the interopercle. Most American species have this weakly developed or absent, but *L. jordani* forms an obvious transition between the two conditions, and this will doubtless be made more complete by an examination of the Asiatic forms. *Lutianus* (*Evoplites*) *viridis* is evidently the descendant of an Asiatic form, and has the notch and knob strongly developed.

The temporal ridges do not join the median frontal ridge, though they are continued well forward and approach it.

In this paper we have used the oldest name, *Lutianus*, for all American species.

184. Lutianus jordani (*Gilbert*).

PLATE XIV, FIG. 29.

Neomænis jordani GILBERT (JORDAN & EVERMANN, 1898, p. 1251).

Head 2¾ to 3 in length; depth 2⅔ to 2¾; eye 4½ in head; dorsal X, 14; anal III, 9; scales 5½ above lateral line, 43 to 47 oblique series running downwards and backwards.

Body deep, with regular curves, the two profiles nearly equal. Snout short, with gently rising upper profile, 3⅓ to 3½ in head. Eye large, its diameter much greater than the width of the preorbital at middle of length, where it is one-seventh length of head. Maxillary reaching slightly beyond front of pupil, its length equaling that of snout and half eye, 2⅖ in head. Least width of preorbital half the diameter of the eye. Temporal ridge ceasing about middle of orbit, much nearer orbital rim than median crest, but not confluent with either. Mandibular teeth in a villiform band, which is of moderate width anteriorly and tapers rapidly on sides. An outer series of distantly placed moderate canines. Teeth in premaxillaries similar to those below, the canines small, a pair on each side enlarged, but small for this genus. Vomerine teeth in a kite-shaped tract, rapidly reaching its greatest width, then tapering slowly backward for twice the distance. The anterior margins are gently concave, the posterior deeply so. Preopercular margin with a rather deep emargination above the angle. The interopercle forms a slight protuberance opposite the preopercular notch, the prominence failing to fill the notch, as it does in *viridis* and other species of the "*Genyoroge*" group. Above the emargination, the edge is very minutely and finely serrulate, at the angle provided with a few short slender rather distant teeth. Gill-rakers strong, those above angle short, all but one tubercular, the one at angle abruptly lengthened, about half diameter of eye; seven developed on horizontal limb of arch. Posterior nostril elliptical.

Five or six series of scales on cheeks, the band running upward to level of upper margin of orbit. A single narrow band of scales on occiput, separated by a naked space from those on nape. Top of head, snout, mandible, preopercle, maxillary, and inferior half of interopercle naked. Scales above lateral line in series parallel with the lateral line; those below lateral line in horizontal series. Scales on the breast not much reduced, as large as those on opercle. Basal half of dorsal and anal with series of scales which form a sheath at base; basal three-fourths of caudal densely scaled.

Dorsal spines heavy, not flexible, the fourth the longest, 2½ to 2⅔ in head. Second and third anal spines about equal, half the length of snout and eye. Soft dorsal and anal low, rounded, the longest ray (measured from free edge of sheath) about one-third head. Caudal lunate, the middle rays three-fourths the outer, 1⅗ in head. Pectorals very long, nearly reaching vertical from vent, 1¼ in head. Ventrals 1⅘ in head.

Color: Back and top of head deep olive; lower half of sides and below dark reddish-purple. Many of the scales on sides with a silvery spot near the margin, producing faint lengthwise stripes. Fins reddish-purple, the basal portions of soft dorsal and caudal tinged with olive. Iris silvery, with an inner and an outer orange circle. No blue lines on the head. Inner lining of gill-membranes and the shoulder girdle largely orange-red. Pectoral fins orange-brown.

Of rare occurrence at Panama, but occasionally taken in considerable numbers. It is a small species, reaching a length of about 40 cm.

185. Lutianus novemfasciatus *Gill.*

Occasional; reaching a large size.

186. Lutianus argentiventris (*Peters*).

With the exception of *L. guttatus*, the most abundant species of the genus. The species is marked by the very slender sharp snout, the profile being concave in front of the nape, convex behind it. The snout is three-eighths to four-elevenths the length of the head, and equals the length of the maxillary; it is not depressed anteriorly. The blue stripe below eye is conspicuous only in the young. It may extend, without interruption, from the tip of the snout along entire side of head to opercular margin. It is more often limited to the anterior part of the head, and becomes variously broken up into a series of dashes or dots.

187. Lutianus colorado *Jordan & Gilbert*.

Not abundant; reaching a large size.

188. Lutianus guttatus (*Steindachner*).

The most abundant species of the genus; never reaching a large size. This species has the temporal region more extensively sealed than in other American representatives of the genus in the Pacific. The usual temporal band of large scales is present, in addition to which are bands of small scales in front of and behind it.

189. Lutianus aratus (*Günther*).

Less abundant than other species of the genus; several specimens secured. The maxillary reaches past the *middle* of the eye.

190. Rabirubia inermis (*Peters*).

A single mutilated specimen was found. The species must be one of the rarest known, as but three specimens have been noted by collectors. The figure published by Jordan (Proc. Calif. Acad. Sci., 2nd Ser., Vol. V, 1895, Plate XXXIX), errs in the number and obliquity of the dark streaks above the lateral line. Nineteen or twenty of these can be distinguished on the specimen from which the drawing was made, and the streak from last dorsal spine runs to the tenth scale of the lateral line. The anal fin contains ten rays in each of the Panama specimens known.

191. Xenichthys xanti *Gill*.

Brought to market in abundance. The best description of this species is that given by Jordan and Gilbert (1882 *a*, p. 325) under the name of *X. xenops*. The following details may be added.

Eye 3 to $3\frac{1}{6}$ in head. Scales 52 to 54; those on head and nape less coarsely ctenoid than elsewhere. The fourth dorsal spine is as long as the third, or sometimes a little longer; the fifth is but slightly shorter. In the declined fin, the fifth spine reaches past the tips of all the other spines anterior to the tenth; the pectoral does not reach the vertical from the vent. In the six specimens counted, the dorsal was constantly XI, I, 18, the anal III, 17.

We have compared this species with *X. agassizii* from the Galapagos Islands, and find it to differ in having fewer scales, a larger eye and a shorter pectoral fin. *X. agassizii* has 58 to 61 scales; the eye is contained 3½ to 3⅔ times in the head; the pectoral reaches to beyond the origin of the anal.

Family HÆMULIDÆ.

192. **Hæmulon scudderi** *Gill.*

The most abundant species of the genus at Panama.

In eight half-grown specimens, five have 11 dorsal spines, three have 12 dorsal spines. In thirty-six young specimens, with the streaks and caudal spot still conspicuous, thirty-three have 11 dorsal spines, three have 12 spines. The articulated dorsal rays are 16 or 17 in number; the anal rays 7 or 8. In twelve specimens from Mazatlan, ten have 12 spines, two have 11.

In young specimens, are three well-developed streaks and one rudimentary one. The uppermost starts on the median line of occiput, runs to the spinous dorsal, and is continued along each side of the base of the dorsal, gradually growing fainter and disappearing before reaching the second dorsal. A pair begin just inside the nostrils, run just above the eyes, diverging backward to a point opposite the origin of the dorsal, thence converging to the base of the last dorsal ray, behind which the pair unite on upper median line of caudal peduncle, on which they reach base of upper caudal rays. Another pair begin at tip of snout and extend backward through eye to middle of caudal peduncle, where they become faint or entirely disappear. A faint streak extends backward from upper margin of orbit to beginning of lateral line, along the anterior part of which it may be faintly indicated. A large black oval spot three-fourths the size of the eye is half on the caudal peduncle, half on the base of the fin. Comparing these streaks, which disappear in adults, with the permanent coloration in *H. macrostomum*, we find them characterized by the rudimentary condition of the streak along (or just below) the lateral line, and the total absence of a streak, present in *macrostomum*, running from above eye along sides just above the lateral line.

H. scudderi differs from its Atlantic representative *H. parra:* (1) In having usually 11 dorsal spines instead of 12; (2) In having longer falcate pectoral fins, which extend beyond the tips of the ventrals, and are nearly devoid of scales; (3) In the greater compression of occiput and nape, forming a crest which may be traced in adults to the interorbital space; (4) In the greater compression of the snout, which is also produced upward at tip, so that in adults the upper profile of snout and head as far as occiput is concave. In *H. parra*, the dorsal spines are normally 12. In but one specimen of *parra* out of sixteen examined, have we found 11 spines, a number which seems not to be recorded for the species. The pectoral fins are short and rounded, not reaching tips of ventrals. They are very densely covered with scales to their tips, both membranes and rays being completely invested. The ventrals also are much more densely scaled than in *scudderi*. The occiput, nape and snout are transversely broadly rounded in both young and old specimens, while the upper profile forms an uninterrupted even curve from tip of snout to front of dorsal, and beyond. The fin and scale formula does not differ from that in *scudderi,* except as noted. There are 52 scales in the lateral line, corresponding with the number of vertical series above it.

Measurements in Hundredths of Length without Caudal.

Species	HÆMULON SCUDDERI		HÆMULON PARRA	
Locality	Panama		Havana, Cuba	
Length without caudal in mm.	205	200	205	198
Head	36	35½	36	34½
Depth	40	37	37	37
Eye	7¼	7½	9	9
Snout	14½	14	15	14
Interorbital (bone)	9	9	7½	7½
Maxillary	15	14½	15	14
Third dorsal spine	15½	15	16	15
Second anal spine	15	14½	13½	13
Length of pectoral	28	29	23	21
Length of ventrals	22	22	21	20
Length of upper lobe of caudal	26	27	20½	20
Height of caudal peduncle	11	10½	11	10

193. **Hæmulon steindachneri** (*Jordan & Gilbert*).

Frequent in the market and about the islands in the bay.

A detailed and wholly satisfactory description of this species is given by Steindachner (1876 *a*, p. 15) under the name *Hæmulon caudimacula.*

194. **Lythrulon flaviguttatum** (*Gill*).

Lythrulon opalescens JORDAN & STARKS (JORDAN, 1895, p. 459, Pl. XL; Mazatlan).

Abundant in the Panama market; often taken with dynamite about the islands in the bay. We have compared our specimens with the type of *L. opalescens,* and find no differences between them. The following account of *opalescens* is based on a re-examination of the type, the published description being faulty in several respects:

Head 3⅖; depth 2¾; dorsal XII, 17; anal III, 10 (the last ray cleft to the base, the parts somewhat separated, the posterior half again forked, both joining the last interhæmal); snout $3\frac{2}{8}$ in head; maxillary $2\frac{3}{5}$; eye (between eyelids) $3\frac{2}{3}$; interorbital width (between edges of frontal bone) 4; longest (fourth) dorsal spine 2; longest dorsal ray $3\frac{1}{4}$; second anal spine $2\frac{2}{3}$; scales 6 or 7–53-14. Gill-rakers 9+17 on one side, 9+19 on the other.

For comparison, we subjoin a statement of measurements and counts based on five Panama specimens of *flaviguttatum*, each about the same length as the type of *opalescens*.

Head $3\frac{2}{5}$ to $3\frac{3}{5}$ in length; depth $2\frac{5}{7}$ to $2\frac{7}{8}$; dorsal XII, 16; XIII, 16; XII, 17; XII, 17; XII, 17; the anal has 3 spines and either 10 or 11 rays; when there are 10 anal rays, the last ray is divided to the base and the two halves are well separated. Snout $3\frac{2}{5}$ to $3\frac{2}{3}$ in head; eye (between eyelids) $3\frac{3}{5}$ to 4; bony interorbital width $3\frac{5}{6}$ to 4; longest (fourth) dorsal spine 2; longest dorsal ray $3\frac{1}{4}$ to $3\frac{1}{8}$; second anal spine $2\frac{2}{5}$ to $2\frac{2}{3}$; scales 6 or 7–51 to 53–13 or 14; gill-rakers usually 10+18 or 9+19, in one specimen 11+20.

195. Orthostœchus maculicauda *Gill.*

Seldom seen by us.

Well described and figured by Steindachner (1870 *b*, p. 12, Pl. VI) as *Hæmulon mazatlanum*. The outline of the spinous dorsal is, however, widely different from that shown in the figure. It is convexly rounded throughout, not concave behind the highest portion of the fin, the second spine exceeds the seventh, and the third is usually slightly longer than the fifth. There is usually a faint indication of the caudal spot.

196. Anisotremus pacifici (*Günther*).

Rather common in the Panama market.

The general color is dusky silvery, with four very faint dusky cross-bars, which correspond in position and extent with the more conspicuous bars of *A. dovii*. The soft dorsal, anal and ventrals are blackish, the caudal and pectorals yellowish.

The species is characterized by the very short, blunt and wide snout, the narrow preorbital, the very large eye, the short pectoral, and the short dorsal and long anal fins almost devoid of scales. The soft dorsal and anal fins are also rounded in contour, the middle dorsal rays being longer than the anterior rays, and the anal fin not emarginate, as it is in *dovii*.

The head is contained $2\frac{9}{10}$ to $3\frac{1}{10}$ times in the length to base of caudal; the depth $2\frac{1}{5}$ to $2\frac{2}{5}$. Eye 4 in head. The preopercular margin is indented above the projecting angle, on which the teeth are moderately or scarcely at all enlarged. Below the angle, the teeth are again reduced and point downward and backward. The normal fin-formula is: dorsal XI, 14; anal III, 10. We find in one specimen only, dorsal XII, 13; and in one other, anal III, 9. The second anal spine is contained $1\frac{2}{3}$ to $1\frac{4}{5}$ times in the head; the third anal spine $2\frac{7}{8}$ to $3\frac{1}{3}$ times. The soft dorsal and anal have short series of scales on basal half only of interradial membranes, the rays, together with the entire distal half of fins, being naked. In both *dovii* and *cæsius*, these fins are densely scaled to their tips. The pectorals are short, not nearly reaching vertical from tips of ventrals, their length 1⅔ in head. The scales on the back are in series parallel with the lateral line, but lose their regularity under the soft dorsal. There are 5½ or 6½ series between the lateral line and the base of the spinous dorsal, and 46 to 48 scales in the lateral line.

197. Anisotremus cæsius (*Jordan & Gilbert*).

This species, known hitherto only from the types taken at Mazatlan and one specimen from Acapulco, was found to be abundant among the islands in Panama Bay. It is readily distinguished from its nearest relatives in the Pacific by its uniform coloration, its longer dorsal fin, and its very long falcate pectoral. The preorbital is also wider, four-fifths diameter of eye. None of our specimens show trace of dark bars. The description of the types answers well to our specimens, but the maxillary extends to middle of eye, instead of "not quite reaching to front of eye." Of nine specimens examined, all had 12 dorsal spines; there were eight with 16 dorsal rays, one with 15; seven with 10 anal rays, two with 9. The third anal spine is longer than in *dovii* or *pacifici*, protruding beyond the wide basal sheath for two-fifths length of head. The caudal is much more deeply forked and the upper lobe more decidedly the longer; the median caudal rays are slightly less than half the upper.

198. Anisotremus dovii (*Günther*).

Occasionally brought to market.

The normal fin-formula in this species is: dorsal XI, 14; anal III, 9. We have no specimen with 12 spines, but this variation is to be expected. The soft dorsal varies to 15, but apparently not to 16. The type was described as having 12 dorsal spines and 16 rays. The vertical fins are scaled to their tips, but the anterior half of each ray, with a narrow strip of the membrane preceding it, is naked. Where the rays fork distally, they become entirely invested. There are 6½ horizontal series of scales between the lateral line and the middle of the spinous dorsal. The pectorals do not extend to opposite tips of ventrals, 1⅓ in head.

This species is very close to *A. pacifici*, but differs in the longer sharper snout, larger dorsal and anal spines, greater scaliness of the fins, the presence of but 9 anal rays, and the intenser color of the bands.

199. Anisotremus interruptus (*Gill*).

We have two specimens, one 23 cm., the other 43 cm. long. They throw no additional light on the relation of *interruptus* to its Atlantic representative *surinamensis*. In both specimens, the scales above the anterior portion of the lateral line are conspicuously enlarged, an oblique series downward and backward from first dorsal spine containing but 7 scales. Specimens of *surinamensis* have somewhat smaller scales, and are darker in color, especially on the fins. These are slight differences, however, and may well prove inconstant. The species *interruptus* should be accepted only provisionally.

200. **Anisotremus tæniatus** *Gill.*

Occasional in the market; of more frequent occurrence about the rocky islands in the Bay.

The species is undoubtedly distinct from its Atlantic representative *A. virginicus*, although some of the characters which have been relied upon to distinguish the two are of no value. Thus, the gill-rakers are alike in both and the eye does not differ in size. The second anal spine is variable in both; in *tæniatus*, its tip usually fails to reach the tip of the soft rays, in *virginicus* it usually reaches beyond their tips.

The most striking difference is in the color, as has been sufficiently described by previous authors. In addition, we note that the fins in *virginicus* are more densely scaled, this being especially well marked with the pectorals. The anterior portion of the spinous dorsal differs widely in contour: in *virginicus*, the third spine is longest, the second five-sixths or more than five-sixths the length of the fourth; in *tæniatus*, the fourth spine is usually the longest, the second very short, not more than four-sevenths the length of the fourth. Our material is not sufficient to enable us to determine the limits of variation in the relative lengths of the dorsal spines. The pectoral seems to be slightly longer in *tæniatus*, and the preorbital a little narrower, but these differences are unimportant.

Measurements in Hundredths of Length without Caudal.

Species	ANISOTREMUS TÆNIATUS		ANISOTREMUS VIRGINICUS	
Locality	Panama		Key West, Fla.	Jamaica
Length without caudal in mm.	170	193	180	143
Head	33	33	33	34½
Depth	49	48	49	49
Eye	8½	8	8	9
Snout	12	12	12	12½
Maxillary	9	9½	9½	9½
Interorbital	9	9	9	9½
Second dorsal spine	10	9½	12½	12½
Third dorsal spine	15½	16	16	17
Fourth dorsal spine	16½	17	15	16½
Second anal spine	16	16½	15½	16½
Length of pectoral	36	36	34	36
Length of ventral	23	22	23½	24
Upper lobe of caudal	29	29	28	29

201. Brachydeuterus nitidus (*Steindachner*).

Four specimens taken. They agree with Dr. Steindachner's description in most particulars.

Head 3 to $3\frac{1}{4}$ in length without caudal; snout 3 to $3\frac{1}{4}$ in head; eye 4 to $4\frac{1}{3}$; interorbital (bone) 5. Scales 48 to 50. Two of our specimens have 9 anal rays, one has 14 dorsal rays; the others have 8 anal and 15 dorsal rays. The upper lobe of the caudal is conspicuously longer than the lower lobe.

202. Brachydeuterus leuciscus (*Gunther*).

Very abundant; the young and half-grown specimens exhibit the same bewildering variety of form and general appearance for which the species is noted in other parts of its range. Compared with adults, the young appear much slenderer, with longer sharper snout, smaller mouth, and less arched frontal region. The preorbital usually appears much wider; but in all these respects there is wide variation among young of the same size. It reaches the length of 31 cm.; adults vary little in appearance, and approach nearly the even contour of *Pomadasis panamensis*. The pectoral is never falcate, and equals the distance from tip of snout to upper preopercular margin.

203. Pomadasis panamensis (*Steindachner*).

This species was very abundant at Panama. Our material shows few variations from Dr. Steindachner's description.

Eye $4\frac{1}{3}$ to $5\frac{1}{6}$ in head; interorbital $4\frac{1}{2}$ to 5; second anal spine $2\frac{1}{3}$ to $2\frac{2}{3}$. The maxillary reaches a vertical from the anterior margin, or the anterior third, of the pupil. Dr. Steindachner's statement that the third dorsal spine is from 2 to $2\frac{1}{6}$ times as long as the second is doubtless a slip of the pen. The third dorsal spine in our specimens varies from 3 to $3\frac{1}{2}$ times the length of the second.

204. Pomadasis bayanus *Jordan & Evermann*.

Pristipoma humile KNER & STEINDACHNER, 1864, p. 222, Pl. I, fig. 1. STEINDACHNER, 1879 *a*, p. 33. Not *Pristipoma humilis* BOWDICH.

Pomadasis bayanus JORDAN & EVERMANN, 1898, p. 1331.

One specimen, 36 cm. long, was taken in the Rio Grande River, at Miraflores, a point above tide-level, where the water is perfectly fresh. A small specimen is in the museum of Stanford University, collected at San José del Cabo, Mexico, by Mr. J. F. Abbott. The records do not show whether this specimen was taken in the river at San José, or in the sea.

The species is very close to *P. crocro*, agreeing with it in general shape and color, and in fin and scale formulæ. Both species have normally 13 dorsal spines. *P. bayanus* has a longer snout, larger mouth and shorter second anal spine. The latter varies greatly with age. In our smaller specimen, it reaches far beyond the tip of the soft rays, to the base of the anal, and is contained 4 times in the length; in the larger specimen, it fails to reach the tip of anal rays, and is contained $6\frac{1}{2}$ times in the length. The dorsal contains 13 spines, 12 rays; the anal III, 7. The scales are very irregular, and difficult to enumerate. We count 52 pores in the lateral line, in each specimen. The head is contained 3 times in the length ($2\frac{1}{8}$ is a misprint for $3\frac{1}{8}$ in Jordan & Evermann's description, *l. c.*).

The eye is contained 5 times in head in the larger specimen, $3\frac{3}{4}$ times in the smaller; snout $2\frac{9}{10}$; maxillary $2\frac{3}{5}$ in large specimen, $2\frac{1}{5}$ in the smaller; fourth dorsal spine $2\frac{1}{5}$ and $2\frac{1}{5}$; second anal spine 2 and $1\frac{3}{5}$. The base of the second dorsal is one-half the base of the spinous dorsal. The gill-rakers are short and weak, 13 on horizontal limb of arch, 3 or 4 of the anterior being rudimentary, immovable.

Striking characters of this species are: the ploughshare-shaped snout, narrowing upward and forward to form a ridge, which terminates in the acutely angulated premaxillaries; and the small accessory scales, which are larger than such scales are apt to be, are more irregular in shape, and are scattered more widely over the surface of the other scales.

205. Pomadasis macracanthus (*Gunther*).

A common species in the market. The following additions to current descriptions are from specimens 18 to 26 cm. in length.

Head $2\frac{3}{5}$ to $2\frac{3}{4}$ in length; depth $2\frac{3}{4}$ to $2\frac{5}{6}$. Eye $4\frac{1}{2}$ to $4\frac{5}{6}$ in head; snout $2\frac{7}{8}$ to $3\frac{1}{8}$; interorbital (bone) 5 to $5\frac{3}{4}$. Three of our specimens have 13 dorsal rays, three have 14. The anal has constantly 8 soft rays, as described by Günther, the last split ray counting as 1; not 7 rays, as given by Jordan and Evermann (1898, p. 1332). Pectoral 3 to $3\frac{1}{2}$ in length.

Our specimens have the scales rather strongly ctenoid, not smooth as described by Günther.

206. Pomadasis branicki (*Steindachner*).

A single specimen was obtained. The dorsal spines seem to be indifferently 13 or 14 in number. There are 14 in our specimen.

207. Orthopristis chalceus (*Günther*).

Very common; seen daily in the markets.

The dorsal spines are usually 12 in number, only one of our specimens has 13; the articulated rays are usually 15 (exceptionally 16). We have found no specimen with 14 rays, as recorded by Steindachner (1870 *b*, p. 3, Pl. II; as *Pristipoma kneri*). The anal rays are usually 11 in number (exceptionally 12). The tubes in the lateral line (corresponding with the series of scales above the lateral line running obliquely downward and backward) are 52 to 54 in number. The diameter of the eye equals the width of the preorbital, $4\frac{2}{3}$ in the head; pectoral $1\frac{1}{5}$ to $1\frac{1}{10}$; snout $2\frac{4}{5}$ to $2\frac{9}{10}$; the maxillary extends beyond the front of the eye. Brownish streaks follow the centers of the rows of scales, alternating with narrower grayish blue streaks along the margins of the rows. No pale streak below the dorsal and no darker cross-bands in any specimens seen by us.

208. Orthopristis brevipinnis (*Steindachner*).

PLATE XV, FIG. 30.

Four specimens, from 28 to 31 cm. long, were obtained by us in the Panama market; no others were seen.

The species has been made the type of a distinct genus (*Isaciella* Jordan & Fesler), differing from *Orthopristis* in the presence of accessory scales, from *Microlepidotus* in the larger scales, the presence of accessory scales on the bases of the larger ones, and the shorter spinous dorsal. A re-examination of *Microlepidotus inornatus* (Magdalena Bay, Albatross collection) shows however that the scales have been incorrectly enumerated in that species. They are in reality of the same size as the scales in *brevipinnis*, there being 60 in the lateral line. There are furthermore numerous small accessory scales on the bases of the larger ones. The dorsal and anal are scaled in *inornatus*, almost as fully as in *brevipinnis*. The two species are very closely related, differing principally in the relative sizes of the two dorsal fins. This difference is not greater than that occurring between species of *Pomadasis* or *Anisotremus*, and seems not worthy of generic recognition. In one specimen of *O. inornatus* from Mazatlan, we find 15 dorsal spines. The only character to separate the two species as a generic group (*Microlepidotus*) distinct from *Orthopristis*, is the possession of the small accessory scales on the sides. This character appears also in *Brachydeuterus*, where *elongatus* and *axillaris* possess it highly developed, while *nitidus* and *corvinæformis* are without it. We have no indication of the condition in the type of *Brachydeuterus* (*auritus*). Should the latter have no accessory scales, the subordinate group consisting of *elongatus* and *axillaris* would be without distinctive name. We have preferred to reduce *Microlepidotus* to the rank of a subgenus, of equal value with *Evapristis*, which forms a transition between it and the ordinary forms of *Orthopristis* with naked fins and no accessory scales.

Steindachner's description of the type of *brevipinnis* (1870*a*, p. 10, Pl. V) refers unquestionably to the present species, but the accompanying figure is so poor and inaccurate as to suggest a very different fish. Prominent among the unfortunate features in this drawing are: the upper contour, which should be evenly curved from snout to caudal peduncle; the dorsal spines, which should be longer and slenderer; the soft dorsal, which is much more completely scaled; the streaks above the lateral line, which are much less oblique, much wider, more irregular and wavy, and less numerous; the series of scales below the lateral line, with their accompanying streaks, which should be horizontal, instead of oblique.

The usual fin formula is: dorsal XIII, 17; anal III, 13 or 14. The third dorsal spine is the longest, $2\frac{1}{3}$ to $2\frac{1}{2}$ in the length of the head. The lateral line contains 60 to 62 tubes.

The scales in the species of *Orthopristis* are more nearly uniform in size than current descriptions would seem to indicate. *O. forbesi*, from Albemarle Island, Galapagos Group, is said to have 80 to 85 series of scales. Examination of one of the types makes it evident that the vertical rows were counted, instead of the oblique rows. The number of oblique rows corresponding to the pores in the lateral line is 65.

Family SPARIDÆ.

209. Calamus brachysomus (*Lockington*).

Chrysophrys calamus GÜNTHER, 1869, p. 421 (Panama).

Known from the Gulf of California, from Panama, and from Santa Helena Bay, near Guayaquil (Boulenger, 1898–9, Vol. XIV, p. 7).

Several small specimens were seen in the market and a number of large individuals were taken by the aid of dynamite about the islands. Four specimens were preserved, ranging in length from 23 to 43 cm.

Its southern representative, *C. taurinus*, is a more slender species and has shorter dorsal spines and a shorter pectoral. Two specimens of *taurinus* which we have examined from the Galapagos are darker in color, especially about the head, and have the inner base of the pectoral blackish.

The original description of *C. brachysomus* contains numerous errors and cannot be relied upon. To the description given by Jordan and Evermann (1898, p. 1453), we make the following additions:

Head $3\frac{1}{5}$ to $3\frac{1}{3}$ in length; depth 2 to $2\frac{1}{4}$. Eye $3\frac{3}{5}$ to $4\frac{1}{2}$ in head; snout $1\frac{3}{5}$ to $1\frac{1}{5}$. The maxillary reaches to below the anterior orbital rim. There are but five very small, short gill-rakers on the lower branchial arch. In our specimens, the dorsal is constantly XII, 12 and the anal III, 10. The third dorsal spine is contained $1\frac{7}{8}$ to $2\frac{2}{5}$ times in the head; the second anal spine is generally longer than the third, but does not reach to its tip in the declined fin. Its length is $3\frac{1}{5}$ to $4\frac{1}{2}$ in head.

Measurements in Hundredths of Length without Caudal.

Species	BRACHYSOMUS				TAURINUS	
Locality	Panama			La Paz, L. C.	Galapagos Islands	
Length without caudal in mm.	286	177	175	255	286	216
Head	31½	31	31	31	34½	31½
Depth	48	46	49	46	43	42½
Eye	7	8	8½	7½	7½	8
Preorbital (least depth)	14½	12	12	13½	14½	11½
Interorbital (bone)	8	8	8	8	8½	8
Snout	19	17	18½	19	20	17½
Maxillary	13	12	12	13½	15	12½
Pectoral	37	37	40	37½	35	36
Third dorsal spine	16½	16	16	17	12	13
Second anal spine	7	8	9½	7	7	6½
Ventral	22	23½	24	22	18	22
Caudal	26	29	31	Broken	26	31
Caudal peduncle (height)	9	10½	11	9	9	9

Family GERRIDÆ.

210. Eucinostomus californiensis (*Gill*).

Diapterus dowii GILL, 1863, p. 162.

We found this species very common at Panama, and carefully selected a series of about twenty specimens, with a view to exhibiting all the variations to which it is subject. We have also a large number of specimens from other localities.

Our extensive series seems to prove *E. dowii* to be invalid. It is alleged to differ from this species in having the maxillary groove "linear" instead of "broad and semi-oval"; in having the scales 5–47–10 instead of 6–44–13, and in having the "spinous dorsal blackish at the margin" rather than "fins immaculate."

Our specimens show all intermediate stages of the maxillary groove, from linear to broadly U-shaped. In some individuals the groove is as wide at the anterior or open end as at the middle, but in most of them it is more or less constricted anteriorly by the encroachment of the scales on each side. In one specimen the groove is wholly closed in front by the meeting of these scales. The scale-formula in our specimens is 5-44 or 45-10. The margin of the spinous dorsal varies in color from dusky to black, but we have some small specimens, collected by the Albatross, in which the fins may be said to be immaculate.

Our specimens of the young up to 65 mm. in length show light brown cross-bars on back. One at the nape runs obliquely downward and backward to the upper end of gill-opening; one at the front of the spinous dorsal runs obliquely downward and forward to lateral line, nearly meeting the one at the nape; between these there is a shorter vertical bar, and more posteriorly are several bars running downward and forward, which become more or less indefinite along the middle of their length. One or two of these bars are represented by the spots on the upper edge and at the middle of the caudal peduncle.

Our material from the Atlantic is so meager that we are unable to discuss relationships between *E. californiensis*, *E. harengulus*, and *E. pseudogula*.

Measurements in Hundredths of Length without Caudal.

Locality	Panama							Chatham I., Galapagos
Length without caudal expressed in mm.	149	153	150	154	149	95	80	156
Head	32	33	31	32	31	33	33	30
Depth	37	38	37	37	36	36	38	32
Eye (inside of adipose eyelid)..	10	10	10	9	9	10	10	9
Pectoral	34	32	32	32	33	33	32	32
Second dorsal spine	19	19	18	18	17½	18	17	17½
Second anal spine	9	9	7½	8	8	9	9	8½
Caudal	27	28	26	27	27	26	....	28
Ventrals	17	18	17	16	17	18	18	16
Snout	11	10	10½	11	10	11½	10	10½
Number of dorsal rays	IX, 9	IX, 9	IX, 9	IX, 9	IX, 9	IX, 9	IX, 9	IX, 9
Number of anal rays............	III, 7	III, 7	III, 7	III, 7	III, 7	III, 7	III, 7	III, 7
Scales	5-44-10	5-44-10	5-45-10	5-45-10	5-44-10	5-44-10	5-45-10	5-45-10

211. **Xystæma cinereum** (*Walbaum*).

Panama records are by Günther, 1869, p. 391 (as *Gerres squamipinnis*); and Jordan, 1885, p. 384.

212. **Gerres aureolus** *Jordan & Gilbert.*

Known only from the type taken by Gilbert at Panama in 1881.

213. Gerres peruvianus *Cuvier & Valenciennes.*

We found this species very common at Panama. From *G. olisthostomus* it differs in having the premaxillary groove scaleless, a smaller eye, smaller and crowded teeth, and a higher sheath of scales to dorsal and anal. From *G. aureolus* (as described) it differs in having the eye not larger than length of snout or width of interorbital, and in having the second dorsal spine much stronger than the others, and much more than half length of head (second dorsal spine of *G. peruvianus* is from $1\frac{1}{10}$ to $1\frac{1}{5}$ in head).

214. Gerres brevimanus *Günther.*

Probably not common; we collected five specimens ranging in entire length from 23 to 36 cm. The species may be at once distinguished from all other American species by the short pectoral, which never reaches the vertical from the vent, and which equals in length the post-nasal part of the head.

The lips are much thickened, especially the lower one. In the smaller specimen the breadth of the lower lip at its widest part is contained $3\frac{3}{5}$ times in the diameter of the eye. In the largest one, it is contained $2\frac{1}{5}$. Between these there is a regular gradation, with the exception of the next to the largest specimen (31 cm. long), in which the lips are much wider than in any other. In this, the lower lips are thickened until they meet on the median line, and appear as a medially divided flap, which extends backward to below the corners of the mouth, where it is truncated. We cannot determine whether this is a sexual character, as our specimens unfortunately have been eviscerated.

The upper profile of the head is concave above the eyes and convex above the nostrils; the snout is blunt, in the large specimens projecting beyond the tip of the lower jaw a third of the diameter of the eye, in the small specimens somewhat less. The eye varies much with the size of the fish and is contained (inside of the adipose eyelid) from $3\frac{1}{2}$ to $4\frac{1}{2}$ times in the length of the head. Its width nearly equals the length of the snout in the smallest specimens; in the largest ones it is contained from $1\frac{1}{2}$ to $1\frac{4}{5}$ times in the snout.

The gill-rakers are very short, 9+13 in number. The exposed portion of the maxillary varies in length from $4\frac{1}{4}$ to $4\frac{3}{4}$ in the length of the head. The ventral spine is stout and blunt, about six-tenths of the longest ventral ray. The second anal spine does not project beyond the third, which about equals the soft rays. The third dorsal spine projects beyond the second, sometimes beyond the fourth.

The streaks along the rows of scales are scarcely fainter than in *G. lineatus;* those above the lateral line are as conspicuous as those below.

Günther's statement that the length of the head is twice and a half in the length of the body is evidently a misprint. It should read thrice and a half.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm.	170	210	227	247	278
Head	30	31½	31½	31½	31
Depth at base of first dorsal spine	45	43	45	42½	45
Eye between adipose eyelids	8½	7½	8	7	7
Snout	9	10½	11	12	10
Exposed portion of maxillary	6	6	7	8	8
Interorbital	10	9½	10	11	10½
Length of pectoral	24	25	24	23	24½
Length of ventrals	25	26	24	24	24½
Second dorsal spine	23	21	22	20	19½
Second anal spine	19	17½	18	16	17
Caudal	36	38	35	34	34
Number of dorsal rays	IX, 10	IX, 10	IX, 10	IX, 10	IX, 9
Number of anal rays	III, 8	III, 8	III, 8	III, 8	III, 8
Scales	6–40–11	6–39–11	6–39–11	6–40–11	6–39–11

Family KYPHOSIDÆ.

215. Kyphosus elegans (*Peters*).

Abundant in the market; also taken by us about the rocky islands. No specimens of *K. analogus* were observed, though these were carefully looked for. It is probable that Panama records of *K. analogus* refer to *elegans*. The differences separating these closely related species are well shown by our specimens. The scales are comparatively large, there being 63 to 68 in the lengthwise series above the lateral line. The anal is more elevated than the dorsal, the height of its anterior rays being contained 1½ times in the base of the soft portion of the fin. There seem to be constantly 13 rays in the second dorsal and 12 in the anal (instead of 12 in one and 11 in the other).

Our specimens vary widely in color. One is almost uniformly deep bronze on head, body, and fins, there being only faint traces posteriorly of the lighter streaks which in other specimens follow the centers of the rows of scales. Other specimens approach more nearly the bright coloration found in *K. analogus*, some of the streaks being noticeably blue.

216. Sectator ocyurus (*Jordan & Gilbert*).

Seen on two occasions only, but present then in considerable numbers.

We have the following corrections to make in the original description: The eye is contained 4½ to 4⅔ times in the head (not 4). The scales on the breast are much reduced in size. The base of the spinous dorsal is two-thirds (not nearly equal to) the length of the soft dorsal or anal. The soft dorsal contains 15 (not 13) rays.

Family SCIÆNIDÆ.

217. **Isopisthus remifer** *Jordan & Gilbert.*

Abundant; known only from Panama. This species is probably distinct from its very close Atlantic representative, *I. parvipinnis*, but no specimens of the two have been directly compared, and the characters alleged to distinguish them are in need of verification. *I. remifer* is said to have longer pectoral fins and more numerous rays in the anal fin. In seven specimens at hand, however, the pectoral is shorter than the description of the type would indicate, equaling the length of the head behind the front of the pupil, and contained $1\frac{1}{8}$ to $1\frac{2}{5}$ in the length of the head. They agree in this character wholly with the type of *I. parvipinnis* (see Jordan, 1883, p. 289), and with its synonym *I. affinis* Steindachner. *I. remifer* is said to have 19 rays in the anal, as contrasted with 16 or 17 in *parvipinnis*. The only reliable information concerning the condition in *parvipinnis* is derived from Steindachner's description and figure of *I. affinis*. In two specimens examined by him, the anal fin contained 16 and 17 rays. In seven specimens of *I. remifer*, the anal counts are as follows: 16, 17, 17, 18, 18, 18, 18. In the type of *remifer*, there are said to be 19 rays. It is impossible to pronounce upon the distinctness of these two species until adequate Atlantic material is at hand for comparison.

The dentition has been insufficiently described by all observers. It differs in no essential respect from that characteristic of *Cynoscion*. The mandible contains an outer series of minute teeth, closely associated with an inner series of elongate canine-like teeth of considerable size. The canines are not definitely 3 in number, as described by Steindachner, but vary from 6, the normal number, to 2 or 3, the missing ones having become accidentally detached. The canines are largest along the middle of the side of the mandible, and cease before reaching the symphysis, the tip of the mandible being occupied by a double series of very small teeth. On the sides of the upper jaw is an outer row of slightly enlarged teeth, and a narrow band of villiform teeth behind it. Anteriorly the band disappears and gives place to a short inner series, the median pair of which are enlarged to form the very conspicuous fangs.

The scales agree in size in the two species, there being 52 to 55 enlarged scales along the lateral line, and above the lateral line 70 to 75 oblique series running downward and backward.

Isopisthus seems to differ inadequately from the genus *Archoscion*, being distinguished only by the longer interval between the dorsal fins.

Measurements in Hundredths of Length without Caudal.

Length to base of caudal in mm.	221	202
Depth	25	24
Head from tip of upper jaw	32	32
Eye	7	7
Maxillary	14	14½
Least width of suborbitals (bone)	1¾	1¾
Interorbital (bone)	6	6
Length of third dorsal spine	12½	13½
Length of fifth dorsal ray	12½	13½
Length of fifth anal ray	11	12½
Length of pectoral	21½	22½
Length of ventrals	16	17
Length of caudal	17½	18
Height of caudal peduncle	9	9

218. **Cynoscion prædatorius** (*Jordan & Gilbert*).

Occasionally coming into the market in considerable numbers, reaching a length of 75 to 110 cm. It is strongly distinguished from all other species of *Cynoscion* by its more oblique mouth and heavier mandible. As this character seems to us insufficient to warrant generic separation, we do not recognize the nominal genus *Buccone* based upon it.

In twelve specimens, three have 18 dorsal rays, seven have 19 rays, one specimen has 20 rays and one but 15. The last-mentioned seems normal in every way. There is no distinct sheath at the base of the soft dorsal. The anal fin contains 2 spines (not 1, as described) and 9 rays.

The scales above the lateral line increase in size posteriorly to below the middle of the soft dorsal, and decrease somewhat on the very slender caudal peduncle. There are 65 to 70 oblique rows running downward and backward. The posterior nostril is obovate in shape.

219. **Cynoscion squamipinnis** (*Günther*).

Not rare in the Bay of Panama.

As stated by Steindachner, the scales along the lateral line are decidedly larger than the others. There are 47 to 50 of these enlarged scales, and an equal number of oblique rows of scales running downward and backward above the lateral line. The enumeration of scales in current descriptions (70 and 85) is based on the vertical series above the lateral line.

The spinous dorsal is shorter than in any other species of the genus, containing constantly 8 spines, of which the first is short, firmly attached to the second, and the eighth usually adnate to the back. The pectorals reach to or nearly to the vertical from the tips of the ventrals.

220. Cynoscion othonopterus *Jordan & Gilbert*.

Obtained at Panama by Gilbert (Jordan, 1885, p. 383); not seen by others.

221. Cynoscion reticulatus (*Günther*).

CORBINA RALLADA.

Abundant; not reaching a large size.

222. Cynoscion albus (*Günther*).

CORBINA AMARILLA.

Abundant at Panama, reaching a large size, specimens 220 cm. long coming frequently to the market. This species and *C. stolzmanni* reach the largest size, and are the most important food-fishes of the genus at Panama. *C. albus* is readily distinguished from other Panama species by the nearly naked dorsal and anal, the lanceolate caudal, the large scales, and the long pectorals. From *C. stolzmanni*, it is additionally distinguished by the wider head, the blunt snout, with its decurved upper profile, by the longer, slenderer caudal peduncle and by the presence of much brassy yellow on the lower half of the sides, this being especially marked in adults. The median caudal rays are also much more produced than in *C. stolzmanni* of the same size, and the lateral line is more arched anteriorly. Opercle largely black on its inner face.

D. IX or X-I, 19 to 22. A. II, 8 or 9. Lateral line with 53 or 54 pores (counted to base of caudal); 57 to 60 oblique rows of scales running downward and backward above the lateral line. Head $3\frac{1}{7}$ to $3\frac{1}{2}$ in length; maxillary $2\frac{1}{3}$ in head. Usually 9 movable gill-rakers on horizontal limb of arch. The sheath of scales at the base of the dorsal fin is much wider than in *C. stolzmanni*. Series of scales accompany the first few rays of dorsal and anal, the remainder of each fin being naked. The posterior nasal opening is narrowly elliptical or ovate, much wider than in *C. stolzmanni*.

223. Cynoscion stolzmanni (*Steindachner*).

CORBINA BLANCA.

Abundant in the Panama market, reaching a length of 220 cm.; the most highly prized representative of the genus at Panama.

We have little to add to Steindachner's excellent description. The depth is contained 4½ times, rather than 4 times, in the length; both dorsal and anal are scaled on one or more of their anterior rays. The species has normally 10 dorsal spines (rarely 9).

The second dorsal and caudal are margined with blackish. The upper half of the axil of the pectoral is black. The membranous fold behind the mandibular teeth is black, contrasting strongly with the rest of the mouth. The gill-cavity is largely blackish, especially the lining membrane of the opercle. The ventrals, pectoral and anal fins are without dusky markings, except on the inner face of the upper pectoral rays.

224. **Cynoscion phoxocephalus** *Jordan & Gilbert.*

This strongly marked form is known as yet only from Panama Bay, where we have found it to be abundant.

The dentition differs in no essential respect from that found in other species of *Cynoscion.* All of the teeth are smaller, including the anterior pair of canines in the premaxillaries. The arrangement differs somewhat from that ascribed to the type. The premaxillary teeth are in a band throughout, which contains everywhere more than two series. Along the sides of the jaw, the outer series consists of stronger conical teeth which are scarcely larger than those behind them. Anteriorly the band widens, and bears along its posterior edge a converging pair of small canines. The mandibular band is widest near the symphysis, where it consists of three series, those of the outer series somewhat stronger than the others. Laterally, the band rapidly narrows, at first to two series, the inner of strong conical teeth, the outer very small; then the outer series disappears, those of the remaining series increasing in size toward the angle of the mouth.

The scales above the lateral line are in 85 to 90 oblique series, downward and backward. Those of the lateral line are enlarged, as usual in the genus, but are so concealed by smaller scales, that they are difficult to enumerate.

The spinous dorsal is more elevated than in other species of the genus, the third spine often reaching the tip of the last spine when depressed. The last dorsal spines are very delicate, one or more of them often lacking; the spines are normally 10 in number. The second dorsal is without a definite scaly sheath; small scales encroach on the thickened base of its anterior rays.

The posterior nostril is a narrowly oblong slit, scarcely larger than the anterior pore-like opening.

In life, grayish silvery above, with bluish and greenish reflections, silvery below; mouth cavity orange-yellow; opercular lining jet-black. A black humeral blotch, concealed by gill-cover. Anal and lower caudal lobe tinged with yellow; fins otherwise translucent-dusky.

225. **Sagenichthys mordax** sp. nov.

PLATE XVI, FIG. 32.

This species, which comes rather abundantly to the market at Panama, has been identified heretofore with *Sagenichthys ancylodon* from the Atlantic. No satisfactory material from opposite sides of the Isthmus has ever been compared, and none from the Atlantic is now available to the authors. But if current descriptions of *S. ancylodon* are at all reliable, there can be no question as to the validity of the form here described, which is distinguished by the greatly enlarged scales along the course of the lateral line, and by the much smaller size of the scales covering the body generally, as shown by the number of oblique rows above the lateral line. The gill-rakers are shorter than in *S. ancylodon*.

Dorsal X, I, 28–30; anal II, 9 or 10. Head $3\frac{1}{4}$ in length; depth $4\frac{1}{2}$. Snout $4\frac{1}{4}$ to $4\frac{1}{3}$ in head; eyes (between edges of adipose eyelids) $6\frac{1}{2}$ in head in adults 38 cm. long, $5\frac{1}{2}$ to $5\frac{3}{4}$ in specimens 25 cm. long. The width of the bony interorbital space is slightly greater than the distance from the tip of the snout to the posterior nostril, slightly less than 5 times in the head. In younger specimens, it equals the length of snout as far as posterior nostril.

The maxillary is longer in young specimens, its length contained 2 to $2\frac{1}{6}$ times in the head; in larger specimens $2\frac{1}{7}$ to $2\frac{2}{7}$. The premaxillaries have an outer series of arrow-shaped teeth, which are very long toward the center of the jaw, and decrease in size regularly toward the angle of the mouth. Anteriorly, behind the outer row, is a short series of three teeth on each side the median line, one of the anterior pair, or rarely both, greatly elongate, much exceeding any of the other teeth in size. Along the posterior half of each premaxillary, there is a narrow inner band of small cardiform teeth, which retain the form of the canines, each tooth having a distinctly lancet-shaped head, and a longitudinally-ridged stalk. Near the hinder end of the band, the outer row of canines become so reduced as to be indistinguishable from the teeth lying behind them. The sides of the mandible contain an inner series of large arrow-shaped canines, and a single outer series of slender teeth, similarly provided with arrow-shaped tips. Anteriorly on each side, the inner series of canines terminates, and an outer series of still larger canines develops, consisting normally of four teeth on each side the symphysis, of which the second pair are the largest. These are not continuous with the outer series of small teeth which occupy the sides of the jaw, as the latter bend around behind the anterior canines, where the two series overlap. The larger canines are subject to frequent injury, and are rapidly replaced by others occupying the same position. The lower jaw projects so that the anterior mandibular canines close outside the upper lip.

The gill-rakers are proportionately longer in young specimens, in which the longest is one-third to two-fifths the diameter of the eye. There are 7 to 9 movable rakers on the horizontal limb of the outer arch.

The dorsal spines are very slender and weak. The membrane behind the tenth spine joins the base of the eleventh, which is attached for its entire length to the first soft ray. All the fins are densely scaled to their tips. The caudal fin is doubly concave, the median rays greatly protruding in the young, less so in adults. The pectoral fins are very long, extending nearly twice as far as the ventrals, $1\frac{1}{4}$ to $1\frac{1}{7}$ in the head in specimens 12 inches long (injured in larger specimens). Ventrals $2\frac{1}{6}$ in head.

The scales are very small, those above the lateral line arranged in about 105 oblique series running downward and backward. The scales bearing the pores of the lateral line are much enlarged, 47 to 50 in number, counted to the base of the median caudal rays. These enlarged scales are covered and in part concealed by small scales similar to those above the lateral line.

In life, grayish brown above, with bluish and greenish reflections, bright silvery below. The dorsal and caudal are dusky, the caudal often with narrow blackish margin, but without any deepening of color in the lower lobe. Ventrals and anal unmarked. Upper half of axil black, the inner face of the pectoral dusky, especially in its upper portion. Gill-cavity more or less dusky.

Measurements in Hundredths of Length without Caudal.

Length to caudal base, in mm.	345	292	229
Depth	22	22	21
Head from tip of upper jaw	31½	31	30½
Eye between adipose eyelids	4¾	5	5½
Maxillary	14½	15	14½
Least width of suborbital (bone only)	1½	1½	1½
Interorbital width above middle of eye	7	6½	6½
Length of third dorsal spine	11	9½	11
Length of soft dorsal base	37	38	36
Height of anal	11	11	12½
Length of pectoral	20½	21	24
Length of ventrals	13	14	14½
Length of caudal (middle rays)	17	19	21
Least height of caudal peduncle	8	8½	8

226. **Nebris occidentalis** *Vaillant.*

GUAVINA.

Nebris zestus JORDAN & STARKS (JORDAN & EVERMANN, 1898, p. 1417).

Abundant.

In *Sagenichthys*, *Isopisthus* and *Nebris*, we have genera each of which is represented by one species on the Pacific coast of Central America, and a supposedly different, but very closely related representative form in the Atlantic. Unfortunately, we have no Atlantic material for comparison in any of these cases. This is to be regretted the more, as no direct comparisons have ever been made, and the distinctive characters relied upon may prove to be fictitious.

Measurements in Hundredths of Length without Caudal.

Length from tip of upper jaw to caudal base in mm.	246	224
Depth	26	24
Head, from tip of upper jaw	31	32
Eye	3½	3½
Maxillary	14	14
Least width of suborbital	4	4
Interorbital (bone)	10	11
Length of third dorsal spine	10	9½
Length of fifth dorsal ray	10½	11
Length of longest anal ray	13	13½
Length of pectoral	27	29
Length of ventrals	19	18
Length of middle caudal rays	22	22
Least height of caudal peduncle	9	8½

227. **Larimus argenteus** (*Gill*).

BOCATUERTA BLANCA.

Very abundant.

In this species, a vertical line from the corner of the closed mouth passes midway between the front of the orbit and the tip of the snout. The length of the snout is two-fifths that of the maxillary. The gape is arched, with the convexity behind. The anterior (lower) margin of the mandible is also strongly arched with its convexity forwards. The eye is smaller than in any other species of the genus, 4¾ to 5 in head, in adults.

In life, very brilliant silvery on sides and below, the upper parts faintly olive, with silvery, greenish and bluish reflections. The dorsal and anal are slightly dusky, the pectorals translucent, the anal and ventrals white or faintly straw-colored.

228. **Larimus effulgens** *Gilbert.*

PLATE XVI, FIG. 33.

Larimus effulgens GILBERT (JORDAN & EVERMANN, 1898, p. 1421).

Very close to *L. acclivis*, with which it agrees in almost all details of structure. The color is, however, bright silvery without trace of stripes, as in *L. argenteus*. The pectoral fin is also much longer.

Dorsal XI, 28 to 30; anal II, 6; pectoral 16; head 3⅒ to 3¼; depth 2⅔ to 3; pores of lateral line 49 or 50.

Mouth slightly more oblique than in *Larimus acclivis*, much less so than in *L. argenteus*. Premaxillaries anteriorly on a level with middle of pupil (lower part of pupil in *L. acclivis*). Maxillary about reaching vertical from front of pupil, $2\frac{1}{3}$ to $2\frac{1}{7}$ in head. Teeth minute, close-set, even, in a single series in each jaw, none of them enlarged. Eye large, $3\frac{1}{6}$ to $4\frac{1}{6}$ in head. Interorbital space $4\frac{1}{3}$ to $4\frac{1}{2}$. Preopercular margin membranous, with flexible ribs ending in minute spinules. Gill-rakers very long, two-thirds diameter of orbit, 19 or 20 on horizontal limb of arch.

Dorsal spines high and flexible, the first two not noticeably thickened. Tenth spine shortest. Third dorsal spine longest, 2 to $2\frac{1}{3}$ in head. Soft dorsal very long, its base $2\frac{1}{3}$ to $2\frac{1}{2}$ in length. The longest dorsal ray equals length of snout and eye. Second anal spine very strong, $2\frac{1}{6}$ to $2\frac{1}{3}$ in head. Pectoral very long and narrow, $1\frac{1}{10}$ longer than head, injured in most specimens. Ventrals reaching to or slightly beyond vent, $1\frac{1}{3}$ in head. Caudal lanceolate, the middle rays much produced, as long as head. Tubes of lateral line much branched. Definite scaly sheaths along bases of dorsal and anal. Basal portions of membranes of vertical fins with series of scales.

Bright silvery, the back grayish. Lining of cheeks black, a small black blotch on upper third of axil. Ventrals, anal and lower caudal rays bright orange-yellow; fins otherwise dusky-translucent.

Rather common at Panama, where numerous specimens were secured.

229. **Larimus acclivis** *Jordan & Bristol.*

PLATE XVII, FIG. 34.

BOCATUERTA RALLADA.

A common species in the Panama market. Our material agrees with the types of the species in those points which are supposed to be distinctive of this Pacific form. The black streaks are conspicuous, and the second anal spine is constantly shorter than the soft rays, $2\frac{1}{3}$ to $2\frac{2}{5}$ in the head. The region about the pseudobranchiæ is largely black.

230. **Larimus pacificus** *Jordan & Bollman.*

Not seen by us; the type dredged by the Albatross in Panama Bay, Station 2802, 16 fathoms. It was subsequently dredged in the Gulf of California, Stations 3021 and 3026, 14 and 17 fathoms.

231. **Odontoscion xanthops** *Gilbert.*

PLATE XVII, FIG. 35.

Odontoscion xanthops GILBERT (JORDAN & EVERMANN, 1898, p. 1426).

Head 3 in length; depth $3\frac{2}{7}$; dorsal XII, 27; anal II, 8; pectoral 17; pores in lateral line 50.

Head and body elongate, compressed, narrow. Dorsal and ventral outlines nearly equally curved. Profile slightly depressed over front of orbits, the snout bluntish, not protruding. Jaws equal, the lower wholly included, the symphysis prominent, slightly passing the premaxillaries. Mouth very oblique, the maxillary reaching slightly behind middle of eye, $2\frac{1}{3}$ in head. Tip of maxillary broad. Mental and rostral pores of moderate size, not conspicuous. A series of slender canines in lower jaw, preceded by an irregular outer villiform row, most evident toward symphysis. The series of canines turns inward and backward on the symphyseal protuberance, the innermost pair enlarged, directed backward. Upper jaw with a series of conical teeth, similar to those on sides of mandible, separated by a considerable interspace from an inner series of very small close-set teeth, directed backward. Eye very large, subcircular, the longest diameter $3\frac{3}{4}$ in head; snout $4\frac{1}{3}$; interorbital width 4$\frac{3}{5}$. A definite supraorbital ridge. Suborbitals narrow. Preopercular margin without definite spines, with minute crenulations, which end in spinous points. Gill-rakers long and slender, 16 on horizontal limb of arch, the longest two-fifths diameter of orbit.

Spinous dorsal very high, of weak flexible spines, none of which are thickened. The third spine is the highest, as long as snout and eye; eleventh spine shortest. Second anal spine strong, equaling length of snout and half eye. Pectorals short, not reaching tips of ventrals, 1$\frac{9}{10}$ in head. Ventrals not reaching vent, extending half way from their base to front of anal. Caudal apparently short and rounded; somewhat mutilated in the type, as are the soft dorsal and anal.

Scales large, weakly ctenoid, except on head, where they are cycloid. Maxillary, tip of mandible, and extreme tip of snout naked; head otherwise completely invested. A definite sheath of scales at base of soft dorsal. Soft portions of all the vertical fins with membranes scaled.

Dark steel-gray, with olive tinge above, silvery below, the lower parts coarsely punctate with brown. Blackish streaks follow the rows of scales, those below the lateral line broad, horizontal, conspicuous; those above lateral line narrower, less intense, the anterior ones directed obliquely upwards, those under soft dorsal nearly horizontal. Fins dusky, the anal, lower caudal lobe, and the terminal portion of ventrals black. Iris bright yellow. Roof of mouth and sides of mandible within orange-yellow, the membrane within mandibular teeth black. Tongue faintly yellow. A dusky yellow bar above and one below pseudobranchiæ, the gill-cavity otherwise silvery.

A single specimen, 19 cm. long, from Panama Bay.

232. **Corvula macrops** (*Steindachner*).

This species is frequent about the islands in Panama Bay. We collected five specimens, which we have examined in connection with a specimen collected at Mazatlan by the Hopkins Expedition.

These all seem to be darker and have more pronounced stripes along the rows of scales than Steindachner's figure (1876*a*, Pl. II) of the type would indicate.

We may supplement the original description as follows: Head 3$\frac{1}{5}$ to 3$\frac{3}{5}$ in length; depth 2$\frac{5}{6}$ to 3$\frac{1}{10}$. Eye 3$\frac{5}{6}$ to 4 in head; snout 4 to 4$\frac{1}{4}$. Two specimens have 52 transverse series of scales; one has 53; three have 54. The anal is constantly II, 10; the dorsal as follows: three specimens, XI, I, 25; one specimen XI, I, 24; one specimen XI, I, 26.

233. **Elattarchus archidium** (*Jordan & Gilbert*).

Frequently taken on sandy shores.

The dorsal formula has been incorrectly given. There are 11 (rarely 10) dorsal spines, and 26 or 27 articulated rays. In eight specimens, the second dorsal contained rays as follows: 26, 26, 26, 26, 26, 27, 27. The diameter of the eye is constantly less than the interorbital width and is contained 4$\frac{3}{4}$ to 5 times in the head; interorbital width 3$\frac{4}{5}$ to 4$\frac{1}{5}$. The caudal is strongly emarginate or shallowly lunate.

Along the sides of the mandible, there is a series of minute teeth along the outer edge of the row of canines (as in *Cynoscion*); as we approach the symphysis these increase in size until they come to equal those of the inner series, which decrease rapidly in size along this part of the jaw. Two irregular series are thus formed, which turn backward on the symphyseal knob, the pair of large canines being the last teeth of the inner series. Along the front and sides of the upper jaw are two series, an outer row of enlarged canine-like teeth (smaller, however, than the large teeth along the middle of the mandible), and an inner row of slender curved cardiform teeth curving directly backward. Those along the front of each jaw are larger and more widely spaced than the others. Behind the middle of the premaxillary, the inner series develops into a narrow band. The canines diminish in size laterally and become finally indistinguishable from the teeth of the band.

A specimen of this species secured by the Albatross in San Juan Lagoon, near Guaymas, Gulf of California, has been compared with our material; no differences appear to exist. In this specimen, also, there are 26 rays in the second dorsal fin.

234. **Bairdiella ensifera** (*Jordan & Gilbert*).

A common fish in the markets. It is well separated from *B. icistia* by the shorter snout, more oblique mouth, more projecting lower jaw, stouter dorsal spines, longer and stouter second anal spine, shorter soft dorsal and rounded spinous dorsal.

Dorsal X, I, 22 in two specimens; X, I, 23 in three specimens; X, I, 24 in three specimens. Snout equals diameter of eye, or is slightly shorter; it is contained from $4\frac{1}{3}$ to $4\frac{3}{4}$ times in head. Anterior margin of premaxillary on a level with a point slightly above lower edge of pupil. The tip of the lower jaw projects a very little beyond the upper.

Dorsal spines all stout, the second the stoutest; the fourth the longest, the fifth and sixth only slightly reduced in length, the others reduced rapidly to the tenth. The posterior outline of the extended spinous dorsal is convex above and concave below. The second anal spine reaches nearly to below the caudal base, the length from $1\frac{1}{3}$ to $1\frac{1}{2}$ in head.

In three specimens of *B. icistia*, the dorsal formula is IX, I, 28; X, I, 27; X, I, 26. The snout is a little longer than eye, its length from 4 to $4\frac{1}{5}$ in head. Anterior margin of premaxillary on a level with a point midway between lower part of eye and lower part of pupil. Tip of lower jaw included. Dorsal spines all slender; the second not stouter than the others, the third the longest. The posterior outline of the extended spinous dorsal is concave, the fin being sharply angulated at the tip of the third spine. The tip of the second anal spine scarcely reaches past the vertical from the tips of the last dorsal rays; its length $1\frac{1}{2}$ to $1\frac{3}{4}$ in head.

235. **Bairdiella armata** *Gill*.

Frequent. In six specimens the dorsal formula is X, I, 23; in five it is X, I, 22 (not XI, I, 21, as described by Jordan and Evermann, 1898, p. 1436).

The longest rays of the caudal fin are just below the middle; above these the fin is slightly concave, below it obliquely truncate. This shape is not well marked in some specimens.

The following color notes are from a fresh specimen: Fins all yellow; ventrals, pectorals, and caudal orange-yellow; spinous dorsal with a large black blotch above; soft dorsal and caudal with dusky margins. Mouth and gill-cavity light yellow.

236. **Bairdiella chrysoleuca** (*Gunther*).

Not uncommon.

An examination of younger specimens than those from which are drawn current descriptions of this species, sheds little additional light on its relations to *B. aluta*. The type of the latter is 19 cm. long. We have at hand one specimen of *chrysoleuca* 19 cm., and one 165 mm. long. In these, the eye is $4\frac{1}{2}$ to 5 in head (not 4, as in *aluta*). The fin counts ascribed to *aluta* are outside the range of variation of *chrysoleuca*, as is also the number of scales in the lateral line. The soft dorsal in *chrysoleuca* varies from 21 to 23 rays (not 18, as in *aluta*); the anal contains 9 rays (not 8) and the lateral line traverses 49 to 51 scales (not 44), the count being made to the base of the middle rays of the caudal. If the account of *B. aluta* is reliable in these respects, the species is certainly distinct.

In our specimens of *chrysoleuca*, the head is contained $3\frac{1}{3}$ to $3\frac{1}{2}$ in the length; the depth $2\frac{5}{7}$ to $3\frac{1}{7}$. The width of the preorbital is contained $1\frac{2}{3}$ times in the diameter of the eye; the longest gill-raker is three-fifths diameter of pupil. The second dorsal spine is much stouter than the third and is not flexible. The filamentous ray of the ventral fin does not nearly reach the vent.

237. **Stellifer oscitans** (*Jordan & Gilbert*).

Frequently brought to market. We preserved six specimens, from 18 to 24 cm. in entire length. To the original description, we add the following:

Head $3\frac{1}{4}$ to $3\frac{3}{5}$ in length; depth 3 to $3\frac{1}{8}$. Eye equals prenasal part of snout (measuring around contour of snout), 5 to $5\frac{3}{5}$ in head. Snout (distance from tip to front of eye) $3\frac{1}{2}$ to 4 in head. Three of our specimens have 24 rays in the soft dorsal, and three have 23. One specimen has but 10 spines in the first dorsal fin.

238. **Stellifer furthi** (*Steindachner*).

Common. A large number collected in the Panama market. We add the following to the original description: Head $3\frac{1}{4}$ to $3\frac{3}{5}$ in length; depth 3 to $3\frac{1}{4}$. Eye $4\frac{2}{3}$ to 5 in head; interorbital $2\frac{4}{5}$ to 3; second anal spine 2 to $2\frac{1}{2}$; ventral spine $2\frac{1}{4}$ to $2\frac{3}{5}$. The maxillary reaches to below a point midway between the posterior edge of pupil and the posterior edge of orbit.

The color of a fresh specimen is as follows: Body light gray above, lower parts of sides silvery, tinged with pinkish salmon. All fins light yellow; soft dorsal with a narrow black margin.

In Jordan and Evermann's description of this species (1898, p. 1441), occur the following statements: "Highest dorsal spine $1\frac{3}{5}$ in head," "ventrals $2\frac{1}{2}$ in head." This seems to have been incorrectly transcribed from Steindachner's description, which gives the length of the third (the highest) dorsal spine as $1\frac{3}{5}$ times the second and about $2\frac{1}{2}$ in the head; the ventral spine $2\frac{1}{2}$ in the head.

239. Stellifer illecebrosus *Gilbert.*

PLATE XVIII, FIG. 36.

Stellifer illecebrosus GILBERT (JORDAN & EVERMANN, 1898, p. 1442).

Head 3 to $3\frac{1}{5}$ in length; depth $2\frac{9}{10}$. D. XIV, 20 or 21; A. II, 11; P. 19 or 20.

Body compressed, rather deep, both outlines curved, the dorsal more than the ventral. Head broad and depressed, but less so than in other species of *Stelliferus*, the interorbital width equaling distance from tip of snout to front of pupil, $3\frac{3}{8}$ in head. Greatest width of head $1\frac{9}{10}$ to $2\frac{1}{10}$ in its length. Upper profile depressed above the orbits, the snout rather bluntly rounded, overlapping the premaxillaries but little. Mouth large, moderately oblique, the gape curved. Maxillary reaching vertical from middle of pupil, or slightly behind this point, its length, measured from front of premaxillaries, $2\frac{3}{4}$ to $2\frac{5}{6}$ in head. Teeth in lower jaw uniform in size, in a villiform band of moderate width, which does not conspicuously increase towards symphysis. Premaxillary teeth in a similar villiform band, with an outer row of enlarged canines, which decrease in size towards the angle of the mouth. Lips thin, but somewhat thicker than in other species of the genus. Five large pores in mandible, and five in snout immediately behind premaxillaries, the inner pair being concealed by overhanging lobes. Back of these are three minute pores. Horizontal diameter of eye $5\frac{1}{7}$ to $5\frac{3}{8}$ in head; length of snout 4 to $4\frac{1}{4}$; least width of preorbital half the diameter of orbit. Vertical limb of preopercle with 8 or 9 rather slender spines, which increase in size towards angle; usually three of those at the angle are enlarged and radiate regularly, or the lowermost may be directed abruptly downwards. The horizontal limb is entire or provided with small flexible spines, loosely attached and projecting but little beyond the integument. Gill-rakers short, slender, the longest nearly half the longitudinal diameter of eye, 5 or 6 above angle of arch, 10 or 11 below.

Spinous dorsal high, the first two spines strong and rigid, the third to the eleventh weak and flexible, the twelfth to the fourteenth again stronger and rigid. Second spine nearly two-thirds the third which is the longest, $1\frac{5}{8}$ in head. The fin diminishes slowly in height to the sixth spine, then more rapidly to the eleventh which is the shortest. The twelfth to the fourteenth progressively lengthen and belong to the second dorsal, the last being more than half the length of the longest ray.

Second anal spine long and slender, about two-thirds the height of the longest ray, equaling distance from tip of snout to front of pupil. Last ray of anal under the third before the last of the dorsal. Pectorals reaching to or nearly to the vertical from the vent, $1\frac{2}{5}$ in the head. Ventrals short, the outer ray filamentous, $1\frac{3}{5}$ in head. Caudal double-truncate, sublanceolate, the middle rays projecting much beyond the outer, $1\frac{1}{4}$ in head.

Scales cycloid on top and sides of head, elsewhere ctenoid. Lateral line more arched than the back, becoming straight slightly behind front of anal fin. Soft parts of all the vertical fins scaled to their tips. Pectorals and ventrals with series of scales along the membranes.

Color in life, plain silvery gray above, silvery below. Dorsals and upper portion of caudal dusky translucent. Pectorals light straw-color. Ventrals mesially orange-yellow, the inner ray, the outer ray, and the tips of all the rays bright white. Anal deep yellow, the rays margined with black. Lower caudal rays yellow. Gill-cavity dusky, without yellow.

Three specimens from the Bay of Panama, the largest 255 mm. long.

As stated below, under *Eques viola*, the last portion of the original published description of *S. illecebrosus* (Jordan & Evermann, 1898, p. 1442), including the color and some structural details, refers instead to *E. viola*, and should be transferred to the description of that species. There should be stricken from the description of *S. illecebrosus* all after the 11th line from the bottom of p. 1442. The statement subsequent to this point: "This species is related most nearly to *Stellifer minor*, in some respects intermediate between *Stellifer* and *Bairdiella*" refers, however, to *illecebrosus*, but was not included in the original manuscript, a copy of which is furnished above. On page 1439 of the volume cited, in the key to species, under the head of *S. illecebrosus*, occurs the statement "coloration dark." This should read "coloration silvery."

240. Stellifer ericymba (*Jordan & Gilbert*).

This little fish is common in Panama Bay. Many specimens were preserved, the largest not exceeding 16 cm. in length.

We have examined in connection with our specimens the description given by Jordan and Evermann (1898, p. 1444) and find it satisfactory.

241. Stellifer zestocarus *Gilbert*.

PLATE XVIII, FIG. 37.

Stellifer zestocarus GILBERT (JORDAN & EVERMANN, 1898, p. 1445).

Head $3\frac{1}{6}$ to $3\frac{1}{4}$ in length; depth $2\frac{6}{7}$ to 3. Pores in lateral line 47 to 50; dorsal XII, 19; anal II, 10.

Comparatively deep and compressed, with narrow head, large oblique mouth, the greatest width of head $1\frac{3}{4}$ to $1\frac{4}{5}$ in its length. Anterior profile rising in an even convex curve to front of dorsal, depressed very little if at all above the orbits. Greatest depth under front of spinous dorsal. Length of caudal peduncle, measured from base of last anal ray, $1\frac{3}{5}$ in head; from last dorsal ray, $1\frac{2}{3}$. Least depth of caudal peduncle $2\frac{5}{7}$ in head.

Head extremely soft, the bones cavernous. Snout bluntish, not projecting beyond the premaxillaries, its length $4\frac{1}{5}$ to $4\frac{1}{2}$ in head. Lower jaw included, the tip produced into a short but distinct symphyseal knob. Mouth large, very oblique, the maxillary (measured from front of snout), equaling length of snout and eye, $2\frac{1}{5}$ in head. Teeth in narrow villiform bands in both jaws, widest in sides of premaxillaries. None of the teeth enlarged. Lips thin. Mental and rostral pores minute. Interorbital space transversely convex, $2\frac{1}{2}$ to $2\frac{9}{10}$ in head. Supraorbital ridges prominent. Preopercle with a wide membranous border, which is strengthened near the angle with diverging ribs. A single rather stiff spine directed backwards, immediately above the angle. Gill-rakers numerous, long and slender, about 20 on horizontal limb of arch, the longest half the diameter of orbit. Eye large, elliptical, the long axis oblique, the greatest diameter $3\frac{2}{5}$ or $3\frac{1}{3}$ in head, equaling distance from tip of snout to front of pupil.

Fins high, densely scaled, including the spinous dorsal. First and second dorsal spines rather strong and stiff, the third and succeeding spines flexible. Third spine longest, $1\frac{2}{3}$ in head. The ninth spine is shortest, the tenth and eleventh longer, belonging to the soft dorsal. The last three spines are stronger and rigid. Second anal spine long and rather slender, $2\frac{1}{3}$ to $2\frac{2}{3}$ in length of head. Longest anal ray $1\frac{2}{3}$ to $1\frac{3}{4}$ in head. Anal basis long, equaling length of snout and eye. Caudal double-truncate, almost lanceolate, the middle rays much produced, $1\frac{1}{4}$ or $1\frac{1}{5}$ in head. Pectorals long, reaching beyond vent, $1\frac{1}{8}$ in head. Ventrals not nearly reaching vent, $1\frac{1}{2}$ to $1\frac{2}{3}$ in head.

Scales thin, deciduous, weakly ctenoid. Head completely scaled.

Nearly uniform grayish silvery above, bright silvery below. Fins slightly dusky. Mouth and gill-cavities silvery white. A blackish blotch in the region of the pseudobranchiæ.

Seven specimens from Panama Bay, the longest about 15 cm. long.

242. Ophioscion typicus *Gill*.

Not common; eight specimens were taken 14 to 21 cm. in length. The description of this species by Jordan and Evermann (1898, p. 1448) was evidently taken from a young specimen. We make the following additions to the original description:

Head $3\frac{1}{3}$ to $3\frac{3}{5}$ in length. Eye $4\frac{1}{4}$ to 5 in head; snout $3\frac{3}{4}$ to 4; interorbital (bone) $3\frac{3}{4}$ to 4; maxillary 3 to $3\frac{1}{3}$; third dorsal spine $1\frac{5}{6}$ to $2\frac{1}{6}$.

In addition to the differences already noted as distinguishing this species from *O. strabo*, we note the lighter pectorals and ventrals, which are colorless or only slightly dusky. In *O. strabo* the pectorals are dark, and the ventrals, with the exception of a white outer ray, are nearly black.

243. Ophioscion simulus *Gilbert.*

PLATE XIX, FIG. 38.

Ophioscion simulus GILBERT (JORDAN & EVERMANN, 1898, p. 1449).

Dorsal X–I, 26; anal II, 7; pectoral 18 or 19; pores in lateral line 50; smaller scales not here enumerated cover the base of the caudal fin. Head $3\frac{3}{8}$ in length, equaling depth.

Body more elongate and less compressed than in other species, the head especially characterized by rounded outlines; preorbitals turgid; snout blunt, scarcely at all compressed, evenly rounded in all directions. Top of head everywhere transversely convex, not at all depressed over the orbits. A scarcely noticeable depression at occiput, with the exception of which the profile rises slowly and evenly to the front of the dorsal fin. Predorsal region transversely evenly convex, not compressed to a ridge, except immediately in front of first dorsal spine. Dorsal and ventral outlines about equally curved, the base of anal fin but little more oblique than the normal contour at that point. Mouth wide, broadly U-shaped as seen from below, overpassed by the bluntly rounded snout for a distance (taken axially) equal to half diameter of pupil. The cleft of the mouth is moderately oblique, the maxillary reaching the vertical from middle of pupil. Length of maxillary (measured from front of premaxillaries) $3\frac{1}{3}$ in head. Mandible with a broad band of villiform teeth of uniform size. Premaxillaries with a similar broad villiform band, preceded by an outer series of small canines, close-set, smaller in size than in related species. Preorbital of moderate width, swollen and turgid as in *Pachyurus*, its width $6\frac{1}{3}$ in head. Posterior nostril large, circular, without trace of raised membranous edge. Anterior nostril vertically elliptical, small, with raised margin. Oblique diameter of eye, $4\frac{3}{8}$ in head. Preopercular margin with 14 to 16 spinous teeth (in the type specimen), the upper ones minute, increasing in size towards preopercular angle, around which they evenly radiate. None of them are conspicuously enlarged, and the lowermost is not directed abruptly downward. Gill-rakers short, the longest about equaling diameter of posterior nostril, 7 movable ones on upper limb of arch, 13 below.

First dorsal high, of very slender flexible spines, except the first two. The second spine is strong and rigid, as long as the fourth, contained $1\frac{3}{4}$ times in the head; the third spine the longest, reaching when declined to base of the spine of second dorsal, its length $1\frac{3}{5}$ in head. From the third, the spines decrease rapidly, so that the distal margin of the fin is subvertical. The tenth spine is the shortest, its membrane reaching base only of the eleventh, which belongs to the second dorsal and is two-thirds as long as diameter of the eye. Second dorsal high, the longest ray equaling length of snout and eye. Caudal sublanceolate, mutilated so that its exact shape cannot be ascertained. The middle rays are considerably longer than the outer, and are at least three-fourths length of head. Second anal spine long and strong, its measured length $1\frac{2}{3}$ in head, slightly greater than that of first soft rays, which however project beyond it. Outer ventral ray produced in a very short filament, about one-fourth diameter of eye. Ventral spine $2\frac{2}{5}$ in head, the longest ray, exclusive of filament, $1\frac{1}{2}$ in head, reaching five-sevenths distance from its base to vent. Pectorals $1\frac{1}{3}$ in head, reaching vertical from tips of ventrals.

Lips, gular membranes, and under side of snout naked, head and body otherwise scaled. Scales on mandible, and a small patch on base of anterior branchiostegals, cycloid; those in advance of nostrils cycloid, or very weakly ctenoid; scales otherwise strongly ctenoid. Second dorsal and anal with a definite low scaly sheath at base, consisting of a single series of small scales and in addition series of scales on the membranes, extending two-thirds distance to tip. Caudal scaled to tip. Lateral line with a long low curve, the height of which equals half diameter of orbit.

Color steel-gray above, without dark streaks, white below, the cheeks and lower portion of sides with much brown specking, sometimes confined to the margins of the scales. Mouth white within. Lining of opercles blackish. Fins dusky, the distal part of ventrals black, the outer ray white. Anal with the anterior rays tipped with black.

A single specimen 187 mm. long.

This species is closely related to *O. scierus*, but differs in the longer, less compressed body, the plain coloration, the turgid preorbitals, less arched lateral line, and smaller canines.

244. **Ophioscion strabo** *Gilbert*.

This species is listed, without remark, by Boulenger (1899, p. 3) from Rio Tuyra, and other rivers on the western slope of the Isthmus of Darien. The species was not seen by us. These Panama specimens should be carefully compared with the closely related species *typicus* and *simulus*, which are known from Panama and closely resemble *O. strabo*.

245. **Ophioscion imiceps** (*Jordan & Gilbert*).

This species seems to be rather rare at Panama. During our stay of six weeks we secured twelve specimens. Like other species of the genus, *O. imiceps* varies greatly in length of snout and diameter of eye.

Head $3\frac{1}{5}$ to $3\frac{3}{5}$ in length; depth $2\frac{6}{7}$ to $3\frac{1}{5}$. Eye $4\frac{2}{3}$ to $5\frac{1}{2}$ in head; snout $3\frac{5}{6}$ to 4; interorbital width $3\frac{1}{5}$ to $4\frac{1}{5}$; second dorsal spine $2\frac{1}{3}$ to 3; third dorsal spine $1\frac{3}{1}$ to 2.

246. **Ophioscion scierus** (*Jordan & Gilbert*).

Plate XIX, Fig. 39.

Common.

The snout projects beyond the mouth for a distance varying from one-third to one-half the diameter of the eye. It increases in sharpness with its length.

Interorbital width (bone) $4\frac{1}{4}$ to $4\frac{1}{2}$ in head (not $5\frac{1}{3}$); snout $3\frac{1}{2}$ to $3\frac{1}{5}$; eye $5\frac{1}{4}$ to $5\frac{5}{6}$. Gill-rakers short, barely movable, 12 on horizontal limb of arch. Soft dorsal with a distinct, rather wide sheath of scales at base; each interradial membrane with a series of scales, rapidly diminishing in size from the base upward, reaching half way to margin of fin. Anal similarly scaled, the basal sheath less clearly defined.

Second dorsal spine very stout, conspicuously stronger than any of the succeeding spines, all of which are slender and weak. The eleventh spine is twice the length of the tenth. The second anal spine is very robust, twice the width of the second dorsal spine, reaching to opposite the tip of the fifth soft ray. Soft dorsal rays 24 or 25.

Opercular lining blackish.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm.	198	150	150	153	171	161	147	163
Head	31	$30\frac{1}{2}$	32	$31\frac{1}{2}$	31	31	$30\frac{1}{2}$	$30\frac{1}{2}$
Depth	31	$31\frac{1}{2}$	32	32	31	32	30	31
Eye	$5\frac{1}{4}$	6	6	$6\frac{1}{2}$	6	$6\frac{1}{2}$	6	6
Snout	$8\frac{1}{2}$	$8\frac{1}{2}$	$8\frac{3}{4}$	$8\frac{1}{2}$	9	8	8	9
Interorbital width	$7\frac{1}{2}$	7	$7\frac{1}{4}$	$7\frac{1}{2}$	$7\frac{3}{4}$	7	7	$7\frac{1}{2}$
Length of pectoral	23	24	26	24	24	24	24	23
Length of third dorsal spine	$16\frac{1}{2}$	$19\frac{1}{2}$	19	$18\frac{1}{2}$	$17\frac{1}{2}$	18	$19\frac{1}{2}$	$16\frac{1}{2}$
Length of second anal spine	$15\frac{1}{2}$	18	17	17	17	17	18	$16\frac{1}{2}$

247. **Sigmurus vermicularis** (*Günther*).

Frequently brought into the market, where we collected nine specimens.

Head from $3\frac{1}{10}$ to $3\frac{1}{4}$ in length. Eye $5\frac{1}{4}$ to $5\frac{1}{5}$ in head; snout $3\frac{7}{8}$ to 4; length of third dorsal spine $1\frac{3}{4}$ to $1\frac{5}{6}$; interorbital (bone only) $4\frac{3}{4}$ to 5. The dorsal formula is as follows: In one specimen IX, I, 27; in four specimens X, I, 27; in four specimens X, I, 26. The anal is constantly II, 8.

248. **Sciæna deliciosa** (*Tschudi*).

According to Jordan and Eigenmann (1889, p. 406), a few specimens of this species, said to have been taken at Panama, are in the Museum of Comparative Zoology at Cambridge, Mass. There are no other references to the occurrence of this Peruvian species at Panama, and the record is in need of verification.

249. **Micropogon altipinnis** *Günther*.

CORBINA LUNA.

Head $3\frac{1}{6}$ to $3\frac{1}{8}$ in length; depth $3\frac{1}{2}$ to $3\frac{1}{5}$. Eye 6 to $6\frac{1}{3}$ times in head; snout projecting beyond the mouth for a distance equaling one-fourth eye. Snout $3\frac{1}{8}$ in head. Anterior nostril very small, circular, with a narrow membranous border, widened posteriorly to form a short flap. Posterior nostril obliquely elliptical, its greatest diameter one-third eye. Maxillary reaching vertical from front or middle of pupil, $2\frac{1}{3}$ in head. Anterior premaxillary teeth of the outer row noticeably larger than those behind them. Usually four pairs of slender mandibular barbels. Upper preopercular serræ very small, increasing in size toward the angle. At the angle, separated from these by a wide interval, is a very strong spine directed downward and backward, below which is a similar but shorter spine directed more obliquely downward. The gill-rakers are very short, the longest two-fifths the horizontal diameter of the pupil, 15 or 16 present on the horizontal limb of the arch.

The dorsal fin contains constantly 11 spines, the last longer than the one preceding. In eight specimens the soft rays number 20, 21, 21, 21, 21, 21, 22, 22. The spinous dorsal is very high, the third spine extending to base of first or second ray of soft dorsal; its length is contained $1\frac{1}{3}$ to $1\frac{4}{5}$ times in the head. The low scaly sheath along the base of the soft dorsal disappears shortly before reaching the end of the fin. The second anal spine is nearly or quite equal to the length of the snout. Pectorals extending well beyond the ventrals, $1\frac{2}{7}$ in the head. Outer ventral ray filamentous, $1\frac{3}{5}$ in head. Caudal with the middle rays longest, the outline of the fin concave above the middle, convex below it.

Scales above the lateral line in very oblique series downward and backward, normally 40 or 41 in number; in one specimen there were but 35 rows, in another 43. An occasional scale is intercalated between these series as they approach the lateral line, the number of pores slightly exceeding the series.

Color as usual in the genus. Upper part of axil dusky. Opercular lining dusky, becoming black posteriorly, where it contrasts strongly with the silvery opercular membrane.

This is a common species at Panama. Our description is based on specimens 31 to 36 cm. long.

250. **Umbrina xanti** *Gill.*

Recorded from Panama by Günther (1868, p. 426, as *U. analis*), and by Gilbert. Not seen by us.

251. **Umbrina dorsalis** *Gill.*

Infrequent; four specimens secured.

Dorsal X, I, 29, 29, 31, 31. Anal II, 7, 7, 7, 8. Eye $4\frac{1}{3}$ to $4\frac{1}{2}$ in head; snout $3\frac{1}{5}$ or $3\frac{5}{6}$. Preopercular margin scarcely serrate, provided with a rather thick membranous border with small flexible teeth.

252. **Menticirrus nasus** (*Günther*).

Menticirrus simus JORDAN & EIGENMANN, 1889, p. 437.

Frequent in the Panama market. The twelve specimens before us differ in the size of the eye and the form of the snout sufficiently to demonstrate the identity of *M. simus* and *M. nasus*, which have been separated on differences similar to those here found.

Head $3\frac{1}{4}$ to $3\frac{1}{2}$ in length; depth $4\frac{1}{5}$ to $4\frac{1}{2}$. Eye equals snout in front of anterior nostril, and is contained $5\frac{1}{4}$ to $5\frac{1}{2}$ in head; snout $3\frac{1}{4}$ to $3\frac{1}{2}$. The third dorsal spine is the longest and is contained $4\frac{1}{4}$ to $4\frac{3}{4}$ in the length. When the fin is depressed, its tip reaches variously from the base of the first ray of the second dorsal to the base of the fourth. Above the lateral line, there are 50 oblique series of scales running downward and backward.

The nostrils are larger than in *M. panamensis*, the anterior nostril round or very slightly oval, distant half its diameter from the posterior nostril. A dermal flap is attached to its posterior edge, and extends back to the posterior nostril. The posterior nostril varies in shape from widely to narrowly elliptical. Its posterior end is usually pointed and reaches the beginning of the adipose eyelid.

The caudal is S-shaped; its upper angulated lobe extends beyond the lower rounded lobe a distance equal to the diameter of the eye.

253. **Menticirrus panamensis** (*Steindachner*).

The most abundant species of the genus at Panama. Fourteen specimens were preserved, the largest 33 cm. in length. The following additions may be made to Dr. Steindachner's description, in the light of our large series.

Dorsal X, I, 20 or 21; anal I, 9. Depth $4\frac{1}{6}$ to $4\frac{5}{6}$ (rather than nearly 4 as stated by Steindachner) in length without caudal; head 3 to $3\frac{1}{4}$. Eye 7 to 8 in head; snout $3\frac{1}{2}$ to 4. The anterior nostril is round, and is separated from the posterior nostril by a space equal to half its diameter. To its posterior edge is attached a dermal flap, which extends back to the posterior nostril. The latter is a little broader than the former, and twice as long. It ends at a distance equal to its length from the orbital edge (exclusive of the adipose eyelid). The outer series of teeth in the upper jaw consists of from 6 to 10 irregularly spaced canines, those in the front of the jaw much enlarged.

When the spinous dorsal is depressed, the tip of the third dorsal spine reaches to, or a very little past, the front of the second dorsal. The length of the third spine is contained in the length of the body 5 to $5\frac{1}{2}$ times; it equals the caudal and is contained $1\frac{1}{8}$ to $1\frac{1}{4}$ in the pectoral (Steindachner describes it as equal to the pectoral). The caudal is conspicuously S-shaped; the upper lobe shorter than in other species; its tip not extending beyond the lower rounded lobe.

M. panamensis differs from *M. nasus* in having a longer head, smaller eye, smaller nostrils placed farther from the eye, larger canines, and shorter dorsal spines. The anal base is longer, the fin is not so much rounded in outline. There are two less dorsal rays and one more anal ray; the upper angulated lobe of the caudal does not project beyond the rest of the fin. *M. panamensis* probably reaches a larger size.

254. **Menticirrus elongatus** (*Günther*).

Frequently seen, but less abundant than *M. panamensis*.

255. **Polyclemus dumerili** (*Bocourt*).

Very abundant in the Panama market during the early part of January. The species has been admirably described by Dr. Steindachner (1875 *b*, p. 31) under the name *Genyanemus fasciatus*. It may be well to note that the pectoral and ventral fins are densely scaled, as well as the soft portions of the vertical fins. Below are given the colors in the fresh state.

Silvery gray on back, sometimes tinged with deep reddish yellow. Lower half of sides, including belly and under side of caudal peduncle, salmon-red. Breast and area about ventrals dusky silvery. Bars jet-black. Sides and top of head dusky. Opercular lining blackish. Under side of head generally, including opercular membrane and under side of snout, tinged with salmon. Dorsal, caudal and pectoral fins straw-color, made dusky by minute points. Soft dorsal with a narrow black margin. Spinous dorsal largely blackish. Anal orange-yellow. Ventrals dusky yellow.

256. Polyclemus rathbuni (*Jordan & Bollman*).

Only the types reported by Jordan and Bollman (1889, p. 162) from Panama.

257. Polyclemus goodei (*Gilbert*).

PLATE XX, FIGS. 40, 40a.

Paralonchurus (*Zaclemus*) *goodei* GILBERT (JORDAN & EVERMANN, 1898, p. 1480).

The homodont dentition and elongate form of this species seem hardly sufficient for generic separation from *Polyclemus*. Its nearest relative is probably *P. peruanus*, Steindachner, a form with deeper body, but with scaly vertical fins and with the outer row of teeth but very little enlarged.

Head $3\frac{4}{5}$ to 4 in length; depth 4 to $4\frac{1}{8}$; dorsal XI, 25 to 27, the spines varying from X to XII; anal II, 7; 45 to 48 rows of scales running obliquely upwards and forwards from the lateral line.

Elongate, with broad heavy head, the temporal region swollen, protuberant. Snout very high and blunt, its anterior profile vertically rounded, little protruding beyond the premaxillaries. Length of snout $3\frac{1}{3}$ to $3\frac{2}{3}$ in head. Rostral and mental pores very large, arranged as usual. The symphysial pore is bounded laterally by two membranous wings, continued forward from the mandibular margins, bearing many barbels. This is the condition also in *Paralonchurus petersi* and in *Polyclemus fasciatus*, no "multifid barbel" being present. The barbels in *P. goodei* are much larger and more numerous than in any other species known to us. They are widely spaced, form a conspicuous series along the inner margin of the mandible, and become crowded into a dense fringe along the anterior half of the margin of the interopercle.

Mouth oblique, the maxillary reaching the vertical from the posterior edge of pupil, a trifle less than one-third head. Teeth slender, villiform, none of them enlarged, those in the lower jaw in a narrow band, in the upper jaw in a much wider band. Teeth nearly all with brown tips. Mouth very protractile. Eye large, $2\frac{1}{3}$ in interorbital width, one-fourth postocular part of head. Preopercle with a membranous edge minutely crenate, spinulescent. Branchiostegal membrane very wide. Pseudobranchiæ covered by membrane, partially concealed. Gill-rakers undeveloped, represented by soft tubercles, of which there are 6 or 8 on the horizontal limb of arch. Two or three next the angle are sometimes slightly longer and movable.

Dorsal spines slender and flexible, the third the longest, equal to length of snout and half eye. Tenth spine shortest. Soft dorsal and caudal densely covered with scales to their tips. No differentiated sheath at base of soft dorsal. Anal fin without scales. First anal spine minute, the second slender but not flexible, one-half to two-thirds length of longest ray. Caudal fin with the lower lobe longest, convex, the upper lobe concave. Longest caudal rays $1\frac{3}{7}$ in head. Pectorals broad, reaching vertical from tips of ventrals, but not nearly to vent, $1\frac{1}{6}$ in head. The ventral spine is inserted slightly behind the vertical from the base of the lowest pectoral ray. Outer ventral ray produced into a filament about one-fourth total length of fin. The longest non-filamentous ray, $1\frac{4}{5}$ in head.

Scales strongly ctenoid. Lateral line with a low wide curve, which grows abruptly steeper in its posterior part, the lateral line becoming straight behind the middle of the anal fin. The scales of the lateral line are enlarged, but are almost wholly concealed by smaller scales.

Color dark grayish brown above and on sides, with greenish and bluish reflections; white below. Back and sides with four broad inconspicuous cross-bars extending downward and slightly backward; the first from predorsal region to base of pectorals; the second from end of spinous dorsal; the third from base of eighth to twelfth, the fourth from twentieth to twenty-fifth rays of soft dorsal. Basal portion of the anal fin, and the outer ventral rays yellow, the distal portions dusky; other fins dusky, the pectorals darker on the inner face, black at axil. Lining of opercle dusky.

Rare at Panama, eight specimens were obtained during a close inspection of the markets for six weeks. Longest specimen 28 cm.

Measurements in Hundredths of Length without Caudal.

			TYPE
Length without caudal in mm.	201	226	230
Depth	25	26	26
Length of head	26½	27½	27
Diameter of eye	4	4	4
Greatest width of preorbital	4	4	4
Width of interorbital	8	8½	8½
Length of snout	8	8	8½
Length of third dorsal spine	13	Broken	11
Length of longest anterior dorsal rays	8½	8	8
Length of third anal ray	12	12	12
Length of pectoral	24	25	24
Length of ventrals	18½	21	20
Length of caudal	23	22	22
Height of caudal peduncle	10½	10	10

258. **Paralonchurus petersi** *Bocourt.*

PLATE XX, FIG. 41.

Rare; but four specimens seen.

The genus *Paralonchurus,* of which *petersi* is the type and the only known species, is well separated from related forms by the cycloid scales and the anterior insertion of the ventral fins. The base of the ventral spine falls in the vertical from the base of the uppermost pectoral ray. The species carries to an extreme the physiognomy peculiar to this section of the family, the eyes being very small, the snout long and depressed, with very large pores, and the fins excessively developed.

Head 3⅕ to 3⅓ in length; depth 4 to 4¼. Dorsal X–I, 33 or 34. Anal II, 8. Lateral line 49 or 50. Interorbital space equaling or slightly exceeding length of snout, 3⅗ in head. Eye 3⅓ to 3½ in interorbital width. Distance from front of premaxillaries to tip of maxillary equaling that from tip of snout to posterior edge of pupil, $2\frac{9}{10}$ to 3 in head. Vertical width of preorbital under front of orbit equals half interorbital width.

The snout projects beyond the premaxillaries for a distance equaling two-thirds the diameter of the eye; it is flattened from above and bluntly rounded from side to side. There is an evident depression above the orbits. Mouth larger than in related species, the maxillary reaching a vertical slightly behind the eye. The teeth are in bands of about equal width in the two jaws, increasing slightly in size toward the inner side of the mandibular band and the outer side of the premaxillary band. Upper jaw with an outer series of enlarged teeth, the basal four-fifths of each tooth finely ridged lengthwise, the terminal one-fifth abruptly smooth, separated from the ridged portion by a shallow transverse groove. This structure is very similar to that found in *Sagenichthys*, except that the terminal portion is flattened and lance-shaped in the latter, but remains conical in *Paralonchurus*. It is interesting to note that most of the teeth are light brown in color, as is usual with arrow shaped teeth. The finer teeth in *Paralonchurus* seem to show a similar structure to that just described.

Pseudobranchiæ are perfectly evident in this genus, never wholly concealed, though covered by the integument. Gill-rakers very short, little movable, 6 developed on the horizontal limb of the arch. Free edge of mandibular ramus with a series of delicate cilia, which are continued forward along the sides of the median pore at the chin. Preopercular margin delicately denticulate, with flexible teeth.

Pectorals very large, twice as long as the ventrals, reaching the vertical from the vent, or the front of the anal fin. The caudal fin is unsymmetrically lanceolate, the longest rays being those just below the middle of the fin, the outline not incurved above or below these. The longest caudal rays equal the longest of the pectoral fin. The outer ventral rays are produced, extending half-way to the front of the anal.

Scales all cycloid, perfectly smooth, those of the lateral line enlarged, covered with very small scales. The caudal is scaled on its middle rays, the other fins wholly scaleless.

In life, the back is grayish-brown, with light blue and bronze reflections; under parts whitish. All the fins, except the spinous dorsal, are deep bright blue, appearing light brown by transmitted light; the blue color persists in spirits. Posterior border of pectoral fins black; inner ventral ray light brownish yellow, the outer filamentous ray whitish; anal with a narrow black margin. Branchiostegal membranes, gular membrane and lips with some yellow. Inside of mouth and gill-cavity, and lining of shoulder girdle orange-yellow. Lining of opercles jet-black, of cheeks dusky.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm.	252	238
Head	30	30
Depth	22½	23½
Eye	2½	2½
Snout	9	9
Greatest width of preorbital	4	4
Interorbital (bone)	9	9
Length of pectoral	29	30
Length of third dorsal spine	10	9
Length of longest anterior dorsal rays	8	7½
Length of third anal ray	11	12
Length of ventrals	14	14½
Length of caudal	26	27
Height of caudal peduncle	9	9½

259. Eques viola *Gilbert.*

PLATE XXI, FIG. 42.

Eques viola GILBERT (JORDAN & EVERMANN, 1898, p. 1486).

The present species and *Stellifer illecebrosus* were originally published in Jordan and Evermann's Fishes of North and Middle America, Vol. II, pp. 1442 and 1486, from manuscript furnished by Dr. Gilbert. While being typewritten, the last manuscript pages of the two descriptions were unfortunately interchanged, with the result that the color, as well as various anatomical details ascribed to *E. viola* belong to *Stellifer illecebrosus* and *vice versa.* In the original description of *E. viola* (t. c. p. 1486), all should be stricken out after the word "reaching" on the fourth line from the bottom of that page. The following description exactly follows the original manuscript:

Head $2\frac{9}{10}$ to $3\frac{1}{3}$ in length to base of caudal; depth $2\frac{5}{17}$ to $3\frac{1}{12}$. D. IX or X, 38 to 41; A. II, 7 or 8; P. 17 to 19. Scales 50 to 54 (oblique series).

Body narrowly wedge-shaped in section, sharply compressed towards dorsal outline, widening below. Lower outline of head horizontal, straight; ventral outline a gentle convex curve to base of anal, which is moderately oblique; lower outline of caudal peduncle slightly concave. The anterior upper profile rises steeply in a very gentle curve to front of dorsal, thence more obliquely to front of soft dorsal, where the depth of body is greatest.

Snout compressed, with rather prominent blunt tip, which slightly overhangs the mouth. Tip of snout and of mandible swollen, provided with large mucous pores, a series of five in the mandible, two transverse series of five each in the snout, of which the posterior lateral pair is minute. Mouth horizontal or very slightly oblique, the maxillary reaching about to vertical from hinder margin of pupil, its length measured from tip of snout $2\frac{3}{5}$ or $2\frac{3}{4}$ in head. Teeth in lower jaw in a wide villiform band, a few of the outer series anteriorly slightly enlarged. Premaxillary teeth in a wide villiform band, the outer series enlarged, forming moderate canines, larger than those in front of mandibular band. Interorbital space narrow, its width contained 5 to $5\frac{1}{3}$ times in the head. Eye large, 4 to $4\frac{1}{3}$ in head. Preopercle entire, the membranous border sometimes minutely crenulate; opercle ending posteriorly in two concealed points, the included opercular membrane covered with fine scales. Gill-rakers short and weak, 5 above the angle, 9 to 11 movable ones below, the longest about four-ninths eye.

Mandible, gular and branchiostegal membranes, and more or less of the snout naked, the scales extending forward in some specimens to beyond the nostrils, in others scarcely beyond the front of orbits. Head otherwise scaled. Lateral line following outline of back, strongly curved anteriorly. The pores of the lateral line are minute, placed on small scales, irregularly wedged in between the larger ones. Above the lateral line are very oblique series running downwards and backwards, and also vertical series. There are about 50 of the former and 90 to 95 of the latter. Scales all ctenoid except those on anterior part of breast, on lower anterior part of cheeks and on interopercle. Vertical fins densely covered to near their tips with small ctenoid scales. Pectorals and ventrals with series of scales on the membranes.

Spinous dorsal short, usually nearly triangular in outline, the second spine the longest, the others rapidly decreasing to the last or next to the last. Longest spine usually as long as snout and eye, sometimes shorter. Soft dorsal long and low, increasing in height backwards, the longest ray about $3\frac{1}{3}$ in head. Depth of caudal peduncle equaling its length behind dorsal fin. Anterior insertion of anal fin about under middle of soft dorsal, the length of caudal peduncle behind anal $1\frac{2}{5}$ to $1\frac{1}{3}$ in head. Second anal spine strong, its length equaling distance from tip of snout to front or middle of pupil and nearly reaching the tips of the soft rays. Caudal convex, the lower lobe slightly longer than the upper. Pectorals short and broad, $1\frac{2}{3}$ to $1\frac{3}{4}$ in head, the upper angle rounded, not reaching as far back as the ventrals, which equal them in length. Axillary scales of ventrals and pectorals very little developed.

Color varying from uniform deep bronze-purple on body and fins, to brownish gray with silvery reflections. Lower parts of head and body somewhat lighter. Tip of mandible white.

Ten specimens, the longest 189 mm., were taken around San José Rock, in the Bay of Panama.

In this species, three slender interneurals, not connected with dorsal spines, lie in advance of the neural spine of the second vertebra. Four interneurals giving attachment to dorsal spines, lie crowded between the neural spines of the second and third vertebræ, the anterior one being very broad. Three interneurals follow, interposed between the third and fourth neurals, and three more between the fourth and fifth.

Family CIRRHITIDÆ.

260. **Cirrhites rivulatus** *Valenciennes.*

The only Panama record for this species is that by Günther (1868, p. 421), based on a specimen secured by Captain Dow. It was not seen by us.

Family POMACENTRIDÆ.

261. **Chromis atrilobatus** *Gill.*

PLATE XXI, FIG. 43.

This species is very abundant about the islands in Panama Bay, where numerous specimens were secured.

It is a strikingly elegant fish in form and color. The upper parts are brownish, shading to silvery on lower sides of head and trunk. The yellowish silvery blotch at base of last dorsal rays and on the contiguous portion of the back is very conspicuous. A jet-black bar, wider in its upper portion, crosses base of pectoral fin and involves its axil. It often fails to reach the lower rays of the fin. The pectoral fin is translucent, unmarked. The ventrals are translucent or slightly dusky. The anal is light or variously dark, but is without distinctive markings. The spinous dorsal is uniformly dusky, the anterior two-thirds of the soft dorsal, including the ray which forms the tip of the lobe, jet-black, with a narrow white margin. The last three or four dorsal rays are translucent. The outer half of each caudal lobe is jet-black, with a narrow translucent margin, the entire central portion of the fin translucent.

The body is slender, tapering regularly backward from the front of dorsal. The top of head is everywhere transversely convex. The longitudinal contour shows a slight but well-defined depression above the eyes. The teeth are in wide bands in each jaw, the outer series conical, stronger than the others. The spinous dorsal is rather low and of nearly uniform height. The soft dorsal and anal are distinctly angulated. Both caudal lobes are produced into filaments, the upper the longer. The fin is very deeply forked, the median rays but one-fourth the longest rays of the upper lobe. The lateral line is discontinued at the anterior edge of the yellow blotch below last dorsal rays. It contains 19 or 20 scales. Each of the scales of the median series on caudal peduncle is distinctly pitted, and contains a small tube which is apparently imperforate, and represents the vanishing stages of the lateral line which formerly occupied this region. The median series of scales on the trunk contains 28 to 30 scales. Between the lateral line and the dorsal sheath are 2½ rows of scales.

The dorsal contains 12 spines and 13 rays; the anal fin 2 spines and 12 rays.

C. atrilobatus resembles strikingly in coloration *C. notatus* from Japan; but the latter is deeper, and has 13 dorsal spines, larger scales, and a black-edged anal fin.

262. Pomacentrus rectifrænum *Gill.*

A large number of adult specimens, 15 to 18 cm. long, are referred to this species.

Two very closely related, yet distinct, species were found associated around rocky islands in Panama Bay. They were separated in the field by their slightly different color and proportions, characters to which we can now add a slight but perfectly constant difference in the fin-counts. Owing to the absence, among our Panama material, of series illustrating changes which occur with age, and to the lack of adults from any other region, our identification of one of these forms with the Mexican species *rectifrænum* is subject to some uncertainty. The second form is described below as a new species (*P. gilli*). Our specimens of *rectifrænum* are almost uniformly light brown, with darker edges to the scales. The head is darker than the trunk, and the ventral and vertical fins are black. The pectorals are distinctly blackish, with a light blotch on the upper rays near the base. A small black spot occupies the extreme base of the uppermost ray. In the majority of specimens, no traces persist of blue spots, but in others of full size, there are very distinct blue spots on the sides and top of head, and on the scales covering the anal fin. In one specimen 14 cm. long, there are in addition distinctly visible the vertical blue streaks on the scales of the sides, which are characteristic of the young of *rectifrænum.*

There are constantly 15 soft dorsal rays, and 13 anal rays, the last split ray being in each case reckoned as one. These numbers hold in our Panama specimens (thirteen in number), and are also found in two young specimens of *rectifrænum* (all to which we have access) from Mazatlan. In Gill's description of the types of *rectifrænum,* he assigns to it 16 dorsal rays and 15 anal rays. It is reasonable to suppose that the split ray at the end of each fin was by him reckoned as two rays. In giving an account of some of the type material furnished him by Dr. Gill, Dr. Günther gives 15 dorsal and 14 anal rays. In their description of the species, Jordan and Evermann assign 13 rays to each fin, but this is certainly an error.

In the adult, the preorbital is very wide, equaling or exceeding the diameter of the eye; the interorbital space is very wide and strongly arched; the margin of the preorbital is smooth or nearly so for some distance behind the angle of the mouth. There are 20 scales traversed by the lateral line, and 26 or 27 in a series along middle of trunk.

Measurements in Hundredths of Length without Caudal.

Length without caudal expressed in mm.	127	125	122	109	122	121
Head	32½	32	31	32	33½	33
Depth	52	60	55½	52½	61	55
Orbit	9	9	8¼	9	8½	9
Interorbital	12½	12½	12	12	12½	12½
Preorbital at end of maxillary	8	8	8	8	8½	8½
Longest dorsal rays	24	25	26	26	24	24
Longest anal rays	22	23	23	23½	23	24
Length of pectoral	27½	30	28½	29	30	29
Length of ventral	28	29	28½	32	30	29
Upper lobe of caudal	30	29	29	31	30	30
Height of caudal peduncle	16	16	16	16½	16½	16
Scales along middle of body	26	27	27	27	27	27

263. **Pomacentrus gilli** sp. nov.

PLATE XXII, FIG. 44.

Very closely related to *P. rectifrænum*, but differing constantly in the uniformly translucent pectorals, the larger eye, the narrower and flatter interorbital space, the narrower preorbital, which is serrated to a point opposite to or in advance of the angle of the mouth, and in the shorter dorsal and anal fins.

Adult specimens, 14 cm. long, are brownish olive, or darker brown, on head and body, including the bases of the vertical fins. Each of the scales on back and sides has a distinct black edge. The vertical fins and the ventrals are black, or in some specimens yellowish. The pectorals are translucent yellow in life, with the upper rays colored like the rest of the fin. There is a blue spot at the base of the upper pectoral rays. Each scale on the sides of the head and on the base of the anal fin is marked with a pinkish blue spot. These are fainter in adults, but were not wholly lost in any of our specimens. The smallest specimen procured is 11 cm. long. The spots are here more generally distributed. Large spots are present on the scales of the four lower series of the trunk, and on the scales in front of the pectoral base. Small spots are present on the scales of the caudal peduncle and on scattered scales on the top of the head and the sides of the trunk, especially evident above the lateral line. The scaly portions of the caudal, the soft dorsal and the pectorals are also marked with small blue spots less conspicuous than those on the anal fin. A few scales on middle of sides show vertically elongated spots, indicating the probable presence in the young of vertical streaks along the rows of scales, as in *P. rectifrænum.* There is no indication in our specimens of blue streaks on the head, but such may well be present in the young.

Head 3⅕ to 3$\frac{1}{10}$ in length; depth 1¾ to 1⅘. D. XII, 14; A. II, 12. The lateral line traverses 20 scales (19 in one specimen); 26 or 27 scales in a series along the middle of the sides; 9 scales in a series between lateral line and anus, 3 between lateral line and front of dorsal. There are fewer accessory scales on top of head than in *P. rectifrænum.*

The preopercular margin is sharply serrate to or slightly below the angle; the horizontal limb is smooth. Preorbital sharply serrate with slender retrorsely curved spines, which occur as far forward as the angle of the mouth, or slightly beyond that point.

The preorbital is narrower than in *P. rectifrænum*, its greatest width, opposite angle of mouth, equaling two-thirds diameter of orbit.

The soft dorsal and anal fins contain constantly 14 and 12 rays, the last split ray being counted as one. Thirteen specimens have been examined as to this point. *P. rectifrænum* has constantly one more ray in the dorsal and anal. The soft dorsal and anal fins are pointed in all our specimens, whereas they are bluntly rounded in *P. rectifrænum.* The ventrals have the outer ray filamentous, extending beyond the vent, usually exceeding the length of the pectoral fin, and equaling the length of the head.

The species is abundant among reefs and islands in Panama Bay. A single specimen was secured at Acapulco.

We take pleasure in naming this species for Dr. Theodore Gill, to whom is due much of our early knowledge of Panama fishes.

Measurements in Hundredths of Length without Caudal.

Length without caudal expressed in mm.	107	105	104	102	107	83
Head	34	32½	34	33	33	34
Depth	56	52	56	53	53	54
Orbit	9	9	9½	9	9½	10
Interorbital	10	9½	10	10	9½	10
Preorbital at end of maxillary	6	6½	6½	6½	6½	6
Longest dorsal rays	26	25	28	26	26	28
Longest anal rays	24	25	27	25	26	27
Length of pectoral	31	31	31½	32	31	30
Length of ventral	31	30	30	32	31	32
Upper lobe of caudal	32½	31	32	31	32	31
Height of caudal peduncle	16½	15	16	16	16	16
Scales along middle of body	27	26	26	26	27	26

264. **Pomacentrus flavilatus** *Gill.*

Not seen by us; recorded by Boulenger (1899, p. 3) from the Gulf of Panama.

265. Nexilarius concolor (*Gill*).

Abundant along rocky shores.

This species shows remarkable resemblance to *Glyphisodon declivifrons*. So far as known, the two do not occupy the same waters, *G. declivifrons* being known only from the coast of Mexico, *N. concolor* from Panama. For description of our Panama material, see Jordan and Evermann (1898, p. 1559).

266. Glyphisodon saxatilis (*Linnæus*).

Very abundant everywhere about rocks.

The sides of body show five well-defined dark bars, as described, but the "sixth faint bar" at base of caudal is usually absent.

Specimens have been compared with material from the Atlantic, and from the Hawaiian Islands.

267. Microspathodon dorsalis (*Gill*).

Seen abundantly at Acapulco and Panama. At Acapulco, on December 20th, numerous small specimens of a very brilliant blue were seen about the rocks of the mole. A larger specimen, 130 mm. long, was obtained. In this, the general color is slaty-black, without blue tinge. The blue on the centers of the scales on trunk has already disappeared, but the pair of larger blue spots on the nape, those above the first, sixth and fifteenth scales of lateral line, and the confluent pair immediately behind last dorsal ray are conspicuous. All the larger scales of occiput and postorbital region are marked each by a blue spot, the spots irregular in size and shape. An occasional scale on the nape is similarly marked. There is an oblong blue spot on the eye above the pupil. An interrupted blue line runs from supraorbital rim anteriorly above the nostril, the two lines converging toward the tip of the snout, but not reaching it. A second broader streak runs forward from below eye to the depression separating tip of snout from preorbital. A third short streak runs backward from the angle of the mouth, continued by a series of two or three blue spots on successive scales. A blue bar crosses the inner base of the upper pectoral rays. Outer margin of ventrals blue. Margins of dorsal and anal narrowly blue to or nearly to the tips of the lobes. Upper and lower margins of caudal pale, the edge narrow and light blue in color near the base of the fin, wider and translucent opposite the middle of the lobes. Soft dorsal and anal fins have the post-lobular margins transparent, this edge widest and best marked on last dorsal rays. Pectorals have a wide terminal translucent bar, occupying about one-third of the fin. The lower region has a generally distributed bluish tint in life.

A larger specimen from Panama, 175 mm. long, is no further advanced toward the mature condition. The color is dark slaty-blue, with broad white margins to the pectorals, and narrower margins to the other fins. The larger sky-blue spots still persist, three above the lateral line, a saddle behind dorsal, and a larger spot on each side of the nape. A profusion of small blue spots cover the top and sides of the head, one above the eye and one behind it being larger than the others. A series of spots form a distinct line below the eye, extending forward on the preorbital. A blue spot surrounds the nostril. The tip of the snout, the anterior (lower) edge of the preorbital, the angle of the mouth and the mandible are blue. There is a very narrow blue margin to the spinous dorsal and to the anterior half of the anal fin. A large blue spot on upper margin of eye-ball.

In older specimens, the conspicuous blue spots and streaks have largely vanished, but the smaller blue spots on sides of head may remain in specimens 25 cm. long. The blue spot on the upper edge of the eye-ball persists in all our specimens.

The ground color varies with the color of the bottom, adults from sand or coral being light gray in tint (*M. cinereus*), while others are blackish or slaty blue.

Family LABRIDÆ.

268. **Harpe diplotænia** *Gill.*

Abundant among the islands in Panama Bay.

269. **Halichæres sellifer** *Gilbert.*

Two specimens were secured, 19 and 24 cm. long. They agree in most details with the description given of the type, the single specimen heretofore known. In both Panama specimens, however, the outer caudal rays are shorter than the middle rays, the posterior margin of the fin being gently convex, even when the fin is spread. In the type, 29 cm. long, the caudal was found to be "truncate or slightly emarginate, the outer rays scarcely produced." The outer caudal rays doubtless become longer with increasing age, as in many of the Labridæ. The outer ventral rays are also shorter in our specimens, where they are less than twice the length of the inner rays, and fail to reach the vent. This also may depend upon the age of the specimens.

In the Panama specimens, the head is contained $3\frac{2}{5}$ to $3\frac{1}{2}$ in the length; the depth 3 to $3\frac{1}{5}$. The depth of the caudal peduncle is $1\frac{7}{9}$ to $1\frac{8}{9}$ in the length of the head. The snout $2\frac{3}{4}$ or $2\frac{9}{10}$ in the head.

The dorsal fin contains 9 spines and 11 rays, the anal fin 3 spines and 12 rays in each specimen. The first anal spine is greatly reduced and concealed in the membrane, and might easily give occasion to a statement that but 2 spines were present.

The colors were essentially as in the type of the species, but were somewhat less brilliant, the bright red of the sides being here of a duller brownish red tint. Following is a description of the coloration of our smaller specimen.

In life, each scale has a basal band of bright blue, the scales otherwise brownish, margined on all sides (including the base) with light yellow or olive.

There are blue spots on the opercles, and two parallel blue streaks from the eye toward the snout. A streak, or a series of spots, on the suborbital ring. Opercles with a pinkish ground color. There is a blackish half-bar under the posterior portion of the spinous dorsal, the bar narrowing rapidly below, and disappearing on middle of sides; it is directed toward the vent, and seems to be more posteriorly placed than in *H. nicholsi*. There is a pinkish bar in front of the base of the pectoral. Caudal yellow. Dorsals brownish red, with a blue margin, and blue streaks running obliquely downward and backward. The anal is yellowish at the base, becoming brownish red toward the margin. There is a narrow blue edge, a blue spot at the base of each ray, and two parallel blue lines anteriorly, which divide that portion of the fin into basal, middle and terminal thirds. The ventrals and pectorals are translucent, the outer ventral rays translucent, margined externally with blue.

270. Halichæres macgregori sp. nov.

PLATE XXIII, FIG. 45.

One specimen 87 mm. long was taken in company with *Pseudojulis notospilus* in a rock-pool on the Panama reef. It was not recognized at the time as a species distinct from *notospilus*, and no color notes were taken.

Head 3 in length; depth $3\frac{6}{7}$; depth of caudal peduncle equals distance from tip of snout to middle of eye. Snout $2\frac{6}{7}$ in head; eye 5. D. IX, 11; A. III, 12.

Anterior canines $\frac{4}{4}$, those in the lower jaw subequal, the outer canines of the upper jaw smaller than the others, but evidently enlarged. A well-developed posterior canine on each side of the upper jaw, this accompanied on one side of jaw by a smaller tooth more posteriorly placed.

The dorsal spines are slender but pungent. The last dorsal ray is split to the base. The first anal spine is reduced to a mere rudiment, which can be detected only on dissection. The last anal ray is split to the base, each half being again partially divided. The caudal is evenly rounded behind. The ventral spine is three-fifths the length of the outer ventral ray, the inner branch of which is longer than the outer, but is not filamentous and does not project beyond the contour of the fin. The ventrals do not quite reach the vertical from the hinder margin of the pectorals, and extend only two-thirds the distance from their base to the origin of the anal. The pectorals cover six scales in a series behind their base.

The scales in front of the dorsal fin fail to cross the median line, the naked space being very narrow posteriorly, but widening rapidly toward the nape. The scales are reduced in size, but are arranged in series continuous with those below and behind them. The scales of the breast are moderately reduced in size, a series anterior to base of ventrals containing 8 scales.

The lateral line is continuous, the posterior portion running on the third series below the anterior portion. The tubes of the posterior portion are simple, those of the anterior portion divided to form two or rarely three branches. Above the dorsally lying portion of the lateral line is a single horizontal series of scales of full size. Above each scale of this series, and forming with it a very oblique row running upward and forward, are four much smaller scales which decrease rapidly in size upward. The uppermost of these are inserted on the base of the dorsal fin, and constitute an incipient sheath. Similar series of reduced scales running downward and forward are found along the anterior portion of the anal fin. There are 7 horizontal series of full-sized scales between the lateral line and the anterior portion of the anal fin.

No trace remains of the brilliant colors which this fish undoubtedly displayed in life. In spirits, the ground color is grayish olive, slightly darker along the back. Many scales have each a dark brown spot at base, those so marked forming rather definite large groups, which correspond on the two sides of the fish. A series of four such groups, separated by narrow interspaces, lie along the lower half of the sides. Behind the eye, are three or four narrow wavy dark lines, the lower two joined more or less by irregular cross-branches. A faint dusky streak runs forward from eye to snout, a faint spot below the eye, and a well marked horizontal dusky streak on lower part of cheeks, turning downward and backward across preopercle. A narrow brown streak runs downward and backward across prepectoral area, but fails to reach the median ventral line.

Spinous dorsal dusky, a small blackish blotch at tip of membrane between first two spines. A very conspicuous elliptical jet-black spot on basal portion of first four rays of the soft dorsal; the spot is faintly ocellated with whitish, above this a faint curved dusky streak, then the translucent margin of the fin. Behind the spot, the dorsal is marked with oblique cross-bands of dusky and whitish. The caudal appears uniformly dusky. The anal is dusky, with a narrow translucent margin. The spine and outer ventral ray are dusky, the rest of the fin whitish. The pectorals are uniformly translucent.

Named in honor of Richard C. McGregor, a member of the expedition to Panama, to the success of which he materially contributed.

271. **Halichæres dispilus** (*Günther*).

The types came from Panama, where the species was also secured by the Albatross (Jordan & Bollman, 1889, p. 182). It has been reported also from Acapulco and Mazatlan.

272. **Pseudojulis notospilus** *Günther*.

The dark bands across the back are in the number of 8, the first being on the nape, the eighth on the caudal peduncle. Those in front of the soft dorsal become progressively fainter, the anterior three, and the one on caudal peduncle, commonly disappearing in adults.

The species is very abundant in all rock-pools about Panama.

273. **Thalassoma lucasanum** (*Gill*).

This species has been recorded from Panama by Günther (1864 *b*, p. 26) without comment. It has not been obtained there by other investigators.

Family SCARIDÆ.

274. **Pseudoscarus perrico** (*Jordan & Gilbert*).

Occasionally taken about the rocky islands in Panama Bay. Five specimens were secured, ranging in length from 23 to 38 cm. The adipose hump on top of head is variable in its development among individuals of the same size. Our specimens are eviscerated, so we are unable to determine whether the development of the hump is dependent on sex.

The following color-notes were taken from a fresh specimen 263 mm. long: Scales on body with the central portion blue, surrounded by brown. Under parts whitish. A wedge-shaped blue spot immediately behind the eye; 4 narrow blue streaks radiate from above the eye; 4 or 5 small spots of blue on the interorbital space; one or more blue streaks in front of eye, and a broad patch below eye. Teeth green. Dorsal fin narrowly margined with bright green; below this the fin is brownish golden, with an imperfect median green band, which is most distinct posteriorly; a basal series of green spots is present. The caudal has the central rays green, the outer ones yellow, edged with green. The anal is largely green, the margin being more brightly colored than the rest of the fin. The pectorals are brownish yellow, margined posteriorly with a translucent band; the upper ray has a greenish margin. The ventrals are greenish white.

There is considerable variation in the size and shape of the green streaks about the eye. Those below the eye are usually wider than those elsewhere, the middle group often coalescent to form a wide blotch. One pair, from upper anterior margin of orbit, sometimes extends well across the top of the head, meeting or nearly meeting on the median line.

Family EPHIPPIDÆ.

275. Chætodipterus zonatus (*Girard*).

This species comes abundantly to the Panama market, but seems not to reach a large size. The longest specimen seen was less than 30 cm. in length, and had not developed the thick bony masses on cranium such as appear in the adult of *C. faber*.

C. zonatus differs from its Atlantic representative *C. faber* principally in the lower lobes of the vertical fins, the shorter ventrals, and the smaller scales. The coloration of the two is essentially the same, there being no difference in the number and arrangement of the bands. These may, however, be a little wider in *zonatus*, which has also a more conspicuous black blotch on the pectoral. The fin-rays are the same in the two species, the dorsal rays varying from 21 to 23, the anal rays from 18 to 20.

The lateral line contains the same number of pores in the two species, 48 to 50, but the scales are notably smaller in *zonatus*, and are less regularly arranged. The smaller scales on the head and on the vertical fins are also noticeably smaller in *zonatus*. The widest portion of the black band which connects the front of the dorsal to the front of the anal has 11 or 12 scales in a longitudinal series across it; in *faber* there are usually but 6 or 8 scales across the widest portion of the band. In *zonatus*, there are 18 to 20 scales in an oblique series on sides between axil and tip of pectorals; in *faber*, there are but 12 or 13 scales on corresponding part of sides.

A specimen of *zonatus* 50 mm. long is very light grayish olive, the bars very faintly indicated or wholly absent. The sides of head and body are marked with scattered sharply-defined brown spots and blotches mostly smaller than pupil. Those on head are arranged in a series along the line of the dark band. On the lateral line, below last dorsal spines, a circular area of the ground color, as large as the eye, is ocellated by a brown line. The third dorsal spine is slightly shorter than in *C. faber* of the same size.

Measurements in Hundredths of Length without Caudal.

	C. ZONATUS	C. FABER
Length in mm.	176	172
Head (to edge of membrane)	31½	32
Snout	12	13½
Interorbital width	12½	12
Diameter of iris	8	8
Depth opposite first anal spine	75	77
Longest dorsal ray	43	70
Longest anal ray	38	54
Longest pectoral ray	19½	19
Longest ventral ray	27½	35

276. **Parapsettus panamensis** *Steindachner*.

Not rare in the Panama market, where numerous specimens were obtained.

In addition to the short graduated dorsal spines, this genus differs from *Chætodipterus* in having no transverse fold behind the upper lip, which is therefore technically as well as actually non-protractile. The shoulder-girdle agrees with *Chætodipterus*. The alisphenoids are much more developed, meeting each other mesially, and closing the cranial cavity in front. The interorbital septum contains a well-developed osseous lamina, which comes in contact posteriorly with the strong, compressed, vertical limb of the basisphenoid. The latter fails to meet the parasphenoid below.

Family CHÆTODONTIDÆ.

277. **Chætodon nigrirostris** (*Gill*).

PLATE XXIV, FIG. 47.

Two adults of this apparently rare species were taken by the use of dynamite near one of the rocky islands in Panama Bay.

In addition to the distinctive color-markings, this species has the scales on the cheeks enlarged, the exposed surfaces much higher than wide, arranged in four horizontal more or less wavy series, but not in quincunx order. The preopercle is strongly striated.

The head and the lower half of body are silvery, more or less washed with light yellow, each scale having often a brownish spot at base, these forming three faint lengthwise stripes along the scale-rows. The base of the anal, and the upper half of the trunk are light brownish purple. A jet-black bar encircles upper part of snout, but does not include the upper lip, nor the region behind the vertical from the nostril. A black blotch above and behind each orbit, fails to meet its fellow by a distance about equaling the diameter of the pupil. A narrow black orbital ring encroaches on the eye-ball. A wedge-shaped black bar has its apex at front of dorsal, its base being separated from the orbital region by a transverse whitish bar which crosses the head behind the eyes. The wedge-shaped bar is bordered behind by a wide silvery band. The opercular membrane is jet-black, as is also the membrane covering the shoulder girdle. A few of the scales covering the supraclavicle are edged or blotched with black. A jet-black bar crosses the base of the upper three-fourths of the pectoral, and is continued into a broader axillary band, which likewise fails to involve the lower rays. A broad black bar begins at base of fifth or sixth dorsal spine, includes the basal half of soft dorsal and is continuous with a wedge-shaped bar on caudal peduncle, the apex of the wedge failing to reach the lower edge of the peduncle, but directed toward the margin of the last anal rays. The remainder of the vertical fins are translucent dusky, unmarked. The ventrals are dusky; the pectorals translucent yellowish.

We have not admitted to our list the Atlantic species *Chætodon capistratus*. recorded without comment from Rio Tuyra, Darien, by Boulenger (1899, p. 3).

278. **Chætodon humeralis** *Günther*.

The young are abundant in tide-pools, and adults are present in large numbers among the rocky reefs and islands in the Bay.

Our youngest specimen is 28 mm. long, and is in the last phases of the "*Tholichthys*" stage. The color scheme of the adult is plainly indicated, but the head is wholly scaleless and is entirely covered with sculptured shields. One of these extends from the occiput on to the nape, in the form of a dagger-shaped spine, which fails to reach front of dorsal by a distance equaling about one-fourth its length. The angle of the preopercle is produced into a rounded squamous process, which extends more than half way to the insertion of the ventral fins. Two similar squamous lobes are attached to the upper portion of the shoulder girdle, their posterior margins being free. The upper is larger and less evenly rounded than the lower, and is separated from it at the point traversed by the lateral line. The margins of these lobes and the preopercular margin are very finely but sharply serrulate. Similar but smaller squamous processes are attached to the horizontal limb of the preopercle and to the inner edge of the dentary, lobes on one side of the head corresponding to indentations on the other, those of the two sides closely joining below and wholly concealing the isthmus and the branchiostegals. The cheeks are firmly cuirassed, like the rest of the head.

The colors are the same as in adults with these exceptions: The ventrals are black. The vertical black bar at base of caudal is faintly indicated. The caudal fin, and the soft dorsal and anal fins are translucent, unmarked, thus contrasting strongly with their barred condition in the adult. The broad bar across posterior portion of trunk is continued definitely on to posterior portion of spinous dorsal, and on to the basal portion of anal spines. There is at no time any ocellus, but a distinct intensification of the black of the posterior bar occurs over a small rounded area immediately below the last dorsal spines.

With increasing size, there appears first the black bar on dorsal and anal, contemporaneously with the broadening of the bar on caudal peduncle. A definite white bar then forms behind the latter, on the basal portion of the caudal fin. Before the sharp differentiation of this bar, white pigment occupies its future position, but covers a wider area, gradually thinning out posteriorly, visible on the entire basal third of the fin. As soon as it becomes concentrated into a narrow bar, a faint dusky margin develops posteriorly, this widening to form a bar, which develops most rapidly on the lower half of the fin. The bars on dorsal and anal are at first near the middle of the fin, leaving a wide translucent margin, but later migrate distally.

The largest of our immature specimens is 55 mm. long. At this stage, the middle dark caudal bar is still much narrower than the basal bar, and there is no trace of the succeeding two bars (white and black).

279. **Pomacanthus zonipectus** (*Gill*).

Much less abundant than *Holacanthus passer*, with which it was found associated. But two individuals were seen.

In adults, the upper profile is continued forward in an even curve to front of nape. From this point, the occipital region is deeply concave, the profile becoming again convex above ocular region and snout. The color has been well described by Dr. Jordan (1895 *b*, p. 484) from Mazatlan examples.

An immature specimen, 63 mm. long, shows the characteristic coloration of the young, which has been described by Jordan and Gilbert (1881 *c*, p. 358), under the name *Pomacanthus crescentalis*. The third yellow band behind the head cuts the bases of soft dorsal and anal fins three or four rays in advance of the posterior ends, instead of running from end to end, as described. It curves forward on the two fins, meeting the anterior yellow band to form a broad loop, which is wider than the bands and blue in color. The dorsal continuations of all save the caudal band are blue. A blue bar is present midway between the first and second, and the second and third yellow bars behind head; no other blue bars are present. The basal two-thirds of the caudal fin is jet-black, save for the narrow vertical yellow bar which divides that area equally. The outer third is translucent, with a narrow dusky bar near the anterior edge of the tract.

280. **Holacanthus passer** *Valenciennes*.

Abundant among rocky islands in Panama Bay.

Gill's type of *H. strigatus*, a synonym of *H. passer*, must have been an immature specimen. In such we find a conspicuous narrow blue streak running from nape to upper posterior margin of orbit, thence faintly downward in a broken line toward base of preopercular spine. This streak disappears entirely in adults. In the young, a second blue streak connects upper anterior margins of orbits, then extends vertically downward behind angle of mouth. The transverse portion of this streak persists in adults and becomes greatly widened.

An oval area in front of dorsal fin contains a number of small bright blue spots, usually one for each scale. The scales behind the white bar are widely margined with blue in adult specimens, but in none do we find traces of the blue cross-bars described by Gill. These may be found in younger specimens than have come to our hands. In adults, that portion of spinous dorsal in front of the white cross-bar is bright yellow. The rest of the fin is deep brown like the body, passing into brownish yellow in the falcate lobe, and as a submarginal band in front of this and behind it. Behind the anterior yellow area, the fin is narrowly margined with bright blue, the margin becoming much wider on the vertical part of the fin. In the young, the dorsal is similarly colored, but the blue margin is wider and includes also the anterior spines, and is everywhere followed by a submarginal yellowish brown band. The anal is similarly marked. The caudal fin and nearly half of the caudal peduncle are light lemon-yellow, the fin posteriorly with a narrow dark brown edge. Pectorals and ventrals lemon-yellow, without other markings. The white bar on sides extends from base of dorsal, below fifth to seventh spines, downwards to a point opposite middle of base of pectorals. It is usually widest in its upper third, narrowing rapidly below. In adults, the dorsal lobe reaches nearly to edge of caudal.

The genus *Angelichthys* Jordan and Evermann, characterized by the absence of spines on the preorbital, by the coarser spines on the ascending limb of the preopercle and by the greater length of the dorsal and anal lobes, should doubtless be considered a section of *Holacanthus*.

Family TEUTHIDIDÆ.

281. **Teuthis crestonis** *Jordan & Starks.*

This species is very near *T. matoides*, from the Hawaiian Islands and the Western Pacific generally, and may prove to be undistinguishable from that widely distributed form. It agrees in most details of shape, color and fin-rays, but appears to differ in having the spine on the side of the tail distinctly smaller, and in having the sides of the body mottled, but not streaked. In specimens 8 to 20 cm. long, the caudal spine is four to five hundredths of the length from snout to base of caudal. In specimens of *T. matoides* from Honolulu, 10 to 23 cm. long, the caudal spine is five to six hundredths of the length. In eight specimens from Panama, the fin-rays are: Dorsal IX, 25, 25, 26, 26, 26, 26, 26, 27; anal III, 23, 24, 24, 25, 25, 25, 25, 25.

T. bahianus from the Atlantic has a still larger caudal spine, which is seven to eight hundredths of the length.

T. crestonis is abundant in the tide-pools of the Panama reef, and among the islands in the Bay. It is recorded from Panama Bay also by Boulenger (1899, p. 3).

Family BALISTIDÆ.

282. **Balistes polylepis** *Steindachner.*

Not uncommon at Panama; three specimens were collected which agree very well with Steindachner's description of the type and co-types from the west coast of Mexico.

It may be distinguished from *B. carolinensis* by the smaller scales, deeper body, more elevated and convex interorbital, less sharply angulated anal, and the shorter caudal lobes. Our three specimens of *B. carolinensis* all have 24 anal rays, while *B. polylepis* has 25 or 26; the lateral series of scales of *carolinensis* are 55 or 56 in number, those of *polylepis* 69 to 73. *B. carolinensis* has the depth of the body contained twice in the length, *polylepis* $1\frac{3}{4}$ to $1\frac{4}{5}$ times; in *carolinensis* the caudal lobes are somewhat longer, more slender and of equal length, while in *polylepis* the lower lobe is the shorter.

Measurements in Hundredths of Length without Caudal.

Length without caudal, in mm	194	207	211
Head	33	$32\frac{1}{2}$	32
Depth	57	57	59
Orbit	$7\frac{1}{2}$	7	7
Snout	26	26	26
Interorbital	11	$10\frac{1}{2}$	11
Length of pectoral	13	13	$13\frac{1}{2}$
Height of anterior part of soft dorsal	$26\frac{1}{2}$	$26\frac{1}{2}$	27
Height of anterior part of anal	$22\frac{1}{2}$	22	23
Length of middle caudal rays	20	19	20
Dorsal rays	III, 28	III, 27	III, 27
Anal rays	26	25	25
Scales, from upper part of gill-opening	69	73	70

283. **Balistes naufragium** *Jordan & Starks.*

The commonest Balistoid in Panama Bay; many specimens were taken about the rocky islands.

We have re-examined the type of the species, from Mazatlan, and correct here a few slight errors in the original description:

Dorsal III, 26; anal 24; scales 50. Head to lower end of gill-slit $2\frac{5}{6}$ in body. Snout $1\frac{1}{6}$ in head; eye $5\frac{3}{4}$; longest dorsal ray $1\frac{2}{5}$; longest anal ray $1\frac{3}{4}$; pectoral $1\frac{1}{8}$.

The groove before eye is very faint, scarcely to be made out in some of our Panama specimens. Dorsal very slightly falcate in the type and in larger specimens; in small and half-grown examples only, is it sharply angulated. The anal is rather sharply rounded. In life the sides are marked with many narrow vertical wavy blue lines.

The species is easily distinguished from *B. polylepis* by the thicker body, the larger scales, the darker and more variegated coloration, the much reduced preocular groove, and the less falcate fins. In *B. polylepis*, the upper margin of the dorsal fin is deeply concave for the whole length; in *B. naufragium*, the greater part of the upper margin is convex, a few only of the anterior rays projecting, making that part of the fin concave. The caudal lobes are also much shorter in this species, while the middle rays are more produced. The plates are much more roughly granular, and are fewer in number. The lips are much thicker and more deeply plicate, the peripheral folds being densely papillose. The ventral stay is more robust, and the circumoral area is devoid of plates.

Measurements in Hundredths of Length without Caudal.

Locality	Panama					Mazatlan (Type)
Length without caudal, in mm	261	216	180	302	165	255
Head	33½	34	35	34	35	34½
Depth	55	56½	58	57	58	56
Orbit	7	7	7½	6½	7	6½
Snout	27	28½	28	28	27	30
Length of pectoral	13½	13½	15	13½	14	15
Height of anterior rays of soft dorsal	25	26	24	24	23	24½
Height of anterior rays of anal	21	20	21	20	19	21
Length of middle caudal rays	19	21	22	19	21	21
Number of dorsal rays	25	26	26	26	26	26
Number of anal rays	24	23	23	24	23	24
Series of scales	51	50	51	51	52	50

284. **Balistes verres** sp. nov.

PLATE XXVI, FIG. 49.

We describe as new the species that has commonly been referred to *B. capistratus* on the Pacific coast of Central America. *B. capistratus* was probably based on East Indian material, but we have had for comparison specimens from the

Hawaiian Islands only. From these, *B. verres* differs in having smaller scales and a greater number of dorsal and anal rays. Specimens from Panama and Mazatlan have the scales 58 to 65; the dorsal has 30 to 32 rays, and the anal 28 or 29. Five specimens of *B. capistratus* from Hawaii have 50 or 51 oblique series of scales (counted from the upper end of the gill-opening); the dorsal has 29 or 30 rays; the anal 25 to 27 rays. The caudal of the Hawaiian specimens is truncate, with the outer rays not produced. The caudal is noticeably lunate in the Panama and Mazatlan specimens. Bleeker's plate shows that his specimen from the East Indies has 50 series of scales, 30 rays in the dorsal fin, and 27 in the anal.

The following description is from the type of *B. verres:*

Head to lower angle of gill-opening 3⅓ in length, without caudal; depth 2. Eye 5⅓ in head; snout 1½; interorbital width 3⅓. Dorsal III, 31; anal 28. Scales from upper end of gill-opening 64.

Teeth with their inner cutting edge produced, the lower ones shutting inside of the upper. The groove before the eye is scarcely longer than the eye. The length of the gill-opening is twice the diameter of the eye, and about equal to the length of the longest pectoral ray.

Groove of spinous dorsal a little longer than first dorsal spine, two-thirds the length of the base of the soft dorsal. Anal base shorter than dorsal base by three-fifths the length of the eye. Anterior part of dorsal a little higher than that of anal. Caudal lunate, the outer rays about one-fourth longer than the middle rays.

Posterior part of sides with 9 or 10 lengthwise series of small antrorse spines. A row of very small pores extends irregularly backward from eye nearly to the front of soft dorsal.

Color in alcohol: upper parts of body brownish slate-color, lighter below. Anterior edge of upper lip, and lower lip and chin light yellowish. A scarcely discernible streak extends backwards across cheek from angle of mouth. Other specimens have this streak very conspicuous, as in *B. capistratus.* Caudal blackish; spinous dorsal dusky, other fins light yellowish.

Measurements in Hundredths of Length without Caudal.

Locality	Panama			Mazatlan		
Length without caudal, in mm.	(Type) 212	281	191	315	250	194
Head	32	34	33	31	33	32
Depth	50	52	52	48	51	49
Eye	6	5	6	5	5½	6½
Snout	28	30	27½	27½	30	28
Height of anterior part of dorsal	15	14½	13½	15	16	16
Height of anterior part of anal	13½	13½	12½	12½	14	14½
Length of pectoral	11½	11	11	10	12	12
Length of caudal (middle rays)	15	16½	16½	15	16	15
Number of dorsal rays	31	31	32	32	30	31
Number of anal rays	28	29	29	29	28	29
Scales	64	65	62	61	61	58

285. **Xesurus hopkinsi** sp. nov.

PLATE XXV, FIG. 48.

Two large specimens, 41 and 43 cm. in length, were taken at Panama, and cannot be referred to any of the described species. For comparison we have specimens of X. *punctatus* from Mazatlan, Clarion Island, and San Benedicto Island; X. *laticlavius* from the Galapagos Islands; and the type of X. *clarionis* from Clarion Island. We have not sufficient material to decide upon the validity of the last-named species, and for present purposes will consider it distinct from the others.

The outlines of the body are evenly curved. The snout projects but slightly as compared with the other species, and the upper anterior outline is shallowly concave. From before eye to dorsal, the profile is regularly rounded and without a projection at nape.

Dorsal VIII, 26 or 27; anal III, 23. The head is smaller than in the other species, 26 or 27 hundredths of the length. In seven specimens of X. *punctatus*, the head averages $31\frac{1}{7}$ hundredths of the length; in three specimens of *laticlavius*, $31\frac{1}{3}$ hundredths; in *clarionis*, 30 hundredths. The mouth is smaller; the maxillary forms but $6\frac{1}{4}$ hundredths of the length (in *punctatus*, $7\frac{2}{7}$ hundredths; in *laticlavius*, $8\frac{2}{5}$ hundredths; in *clarionis*, 8 hundredths). The teeth are much smaller, though they number the same as in the other species, 8 or 9 on each side of the upper jaw. The eye is smaller, 4 or $4\frac{1}{2}$ in the snout, 5 hundredths of the length (in *punctatus* $6\frac{2}{7}$ hundredths; in *laticlavius*, $7\frac{5}{6}$ hundredths; in *clarionis*, $6\frac{1}{2}$ hundredths).

The pectoral is broad and rounded at its tip, reaching to above the base of the second anal spine, when forced into a horizontal position. It seems to incline obliquely upward in its normal position. The ventrals nearly reach the first anal spine, and are about two-thirds the length of the pectorals. The dorsal and anal are as in related species. In the larger specimen, the first dorsal spine has become almost entirely concealed beneath the skin, the first anal spine wholly concealed.

The posterior part of the body is rather thickly covered with sharp spines, the bases of which are expanded as rough plates. The spines are somewhat inclined forward and are occasionally bifid (some specimens of other species have scattered rough plates which sometimes bear low sharp keels, but never high spines). The three bony shields on the caudal peduncle bear thick blunt spines, their points broad and smooth, as though worn.

Color light slaty on lower parts, dark above. One specimen is faintly spotted with black on nape and opercles.

Measurements in Hundredths of Length without Caudal.

Length without caudal, in mm	360	335
Head	27	26½
Depth	51	49
Maxillary	6¼	6¼
Eye	5	5
Horizontal limb of preopercle from behind fold in mandible	11	12
Vertical limb of preopercle	13	13
Length of pectoral	26	25
Length of ventral	16	16
Length of fifth dorsal spine	12	11
Longest anal rays	12	12
Height of caudal peduncle just behind base of dorsal	11½	12
Length of longest caudal ray in upper lobe	24½	23½

Family TETRAODONTIDÆ.

286. **Spheroides angusticeps** (*Jenyns*).

Not seen by us; recorded from Panama by Jordan and Gilbert (1882 *n*, p. 631) from the Bradley collection, and by Jordan and Bollman (1889, p. 183).

287. **Spheroides lobatus** (*Steindachner*).

Obtained at Panama by the Albatross; not seen by us.

288. **Spheroides testudineus** (*Linnæus*).

Probably rather rare at Panama, where four specimens were taken. Compared with others from Jamaica, they seem to show a slight difference in the length of the head and snout, but our series is insufficient for the verification of this distinction. Our specimens are much bleached, so that nothing can be made out except the pattern of coloration, which agrees with that of the Jamaica specimens. No satisfactory comparisons can be made as to the size of spots, or the distinctness of markings.

This species differs from *S. annulatus* in having the interorbital space (bone) narrower, the dorsal and anal shorter, the spots a trifle larger, and the termination of the dorsal and the anal further from the caudal, the insertion of the fins being more anterior and the base shorter. As the interorbital increases in width with age, only specimens of about the same size should be compared in this respect.

Measurements in Hundredths of Length without Caudal.

Locality	Panama			Jamaica			
Length without caudal in mm.	164	150	135	168	137	133	151
Head from teeth to middle of gill-opening	32	33	33	34	35½	34	34
Depth at occiput	21½	23	21	23	25	22	22½
Orbit	7	7½	6	6	7	7	7½
Interorbital (bone)	7½	8	8	7	7½	7½	7½
Snout (from teeth)	16½	16½	17½	18	18	18	17½
Length of dorsal	18	18	17½	16½	17	18	17½
Length of anal	15	15	14	13½	14	15	15
Length of caudal	24	25	24	25	25	24	25
Termination of dorsal from caudal	14	13	14	14½	13	14	14
Termination of anal from caudal	13	13	13½	13½	13½	13	13½
Number of dorsal rays	8	8	8	8	8	8	8
Number of anal rays	7	7	7	7	7	7	7

289. Spheroides annulatus (*Jenyns*).

Appearing frequently in the Panama market. The young are common also in the tide-pools, associated with the young of *Tetraodon hispidus*. In the young, the concentric rings are less variable and less interrupted than in adults. The ground color of the back is generally not broken up into small spots, as is so frequently the case in adults. The spots on the sides are usually larger and fewer in the young, or are sometimes entirely absent. The caudal is rather abruptly blackish upon its posterior half, the other fins are colorless.

One specimen, 15 cm. in total length, differs from all the others in the somewhat more prominent sharper spines, and the very different coloration. Upon the middle of the back is an S-shaped marking, the extremities of which are equidistant respectively from the eye and the front of the dorsal, the interval being in each case twice the diameter of the eye. Around it are very irregular incomplete rings. A curved line runs from just behind the eye to the middle of the gill-opening and another from the nape to above the base of the pectoral fin. Across the snout and caudal peduncle are irregular lines. The sides have fewer spots than is usual, and the fins are as here described for the young. The measurements of this specimen are the third listed in the appended table.

We have examined specimens from Mazatlan, La Paz, and the Galapagos Islands. Some of the larger northern specimens (*S. politus*) have the color of the back broken up into smaller spots than in the southern specimens, though some of the smaller northern specimens are like the southern in this as in other respects. *Spheroides politus* has been recorded from Panama (Jordan & Bollman, 1889, p. 183) and from Santa Helena Bay (Boulenger, 1898–99, Vol. 14, p. 8). We consider it identical with *annulatus*. The Galapagos specimens vary greatly in depth of color. One has the back, pectoral, dorsal, and caudal very dark brown, almost black, while the anal is dark. The color of the back grades in other specimens to light brown, while the fins are nearly colorless. One specimen differs from the others in having a very concave interorbital.

Measurements in Hundredths of Length without Caudal.

Locality	Panama			Galapagos				La Paz, Mex.	Mazatlan, Mex.	
Length without caudal in mm	200	158	121	170	185	200	116	215	114	92
Head from teeth to middle of gill-opening	37	36½	36½	34	35	34	35	36	36½	35
Depth at occiput	24	24	24½	25	24	24	24	24	23	22
Orbit	5½	7	5½	7	6	4½	8	5½	6	7
Interorbital (bone)	13	12	9	10½	12	11½	10	13	10	7½
Snout (from teeth)	20½	19	16½	16½	18½	18	18	20	18	18
Length of dorsal	18	18	18	20	19	19	19	19	18	17
Length of anal	16½	16½	15	18	16½	17	16½	16½	15½	16
Length of caudal	24	26	26	25	24	24	25	24	25	25
Distance from tip of dorsal rays to caudal	9½	8½	10	8	7	8	9	8	9	10
Distance from tip of anal rays to caudal	9½	8	9½	7½	8	7½	9	7	10	10
Number of dorsal rays	8	8	8	8	8	8	8	8	8	8
Number of anal rays	7	7	7	7	7	7	7	7	7	7

290. **Spheroides furthii** (*Steindachner*).

A rare species, not taken by us; recorded from Panama by the describer, and by Jordan (1885, p. 393) from the Gilbert collection.

Guentheridia gen. nov. (*Tetraodontidæ*).

Type, *Tetrodon formosus* Günther, 1870, p. 283.

This genus differs from *Spheroides* in the character of the olfactory organ, which is a transversely-placed tube, open at each end to its full diameter. The outer end is squarely, the inner obliquely, truncate, making the upper margin of the tube very narrow. The inner surface of the tube is closely covered with large cup-shaped pits, visible to the naked eye. To these pits the olfactory nerve is distributed; they are undoubtedly the end organs of the nerve.

Similar pits are developed in the genus *Tetraodon* (*erethizon*, *setosus*, *aerostaticus*, *perspicillaris*, *hispidus*), where they occupy the inner surface of the nasal flaps; but they are not found in other genera. The nasal organ of *Tetraodon* could be formed from that of *Guentheridia* by cutting through the upper edge of the tube, thus leaving two lobes springing from a common base.

The American species of *Spheroides*, nearly all of which we have examined, have the olfactory tubes with small openings, and without cup-shaped pits on their inner surfaces; the latter are smooth, or are sometimes provided with one or two slight folds of skin.

291. Guentheridia formosa (*Günther*).

Common at Panama, twelve specimens being secured. In addition to these we have examined six specimens collected by the Albatross at Panama in 1888. We found no young of this form, though the young of *Tetraodon hispidus* and *Spheroides annulatus* were common in the tide-pools.

The color pattern is variable. In some examples the spots are almost evenly distributed over the back and upper part of the sides, with no indication of concentric arrangement. Other examples have the spots confluent into smooth concentric rings, arranged with the smallest ring in the middle of the back. Between the examples with scattered spots and those with smooth rings are all intermediate stages—some with the spots arranged concentrically but not united, some with them more or less united, forming rings with uneven contour. The spots vary also in size. Sometimes they are little more than half the size of the eye, and are separated by interspaces of the gray ground color of about their own width, sometimes they are as large as the eye, or larger, and are so closely set that the ground color shows only as narrow lines between them. In one specimen some of the spots have fused into small irregular rings about twice the size of the eye, and enclose small spots of the ground color. The top of head has transverse rows of spots or solid bars. The latter are sometimes united in pairs, forming wider and fewer bars.

Tetraodon formosus was described from a single specimen from South America. The type description is not detailed, so the identification with this Panama form must be considered provisional, until direct comparison can be made with the type.

292. Tetraodon hispidus *Linnæus*.

Arothron erethizon JORDAN & GILBERT, 1882, p. 631.

This species is not rare about the rocky islands in Panama Bay, where numerous specimens were obtained, ranging from 15 to 330 mm. long. The long quill-like spines protrude only when the fish is inflated. When retracted, the position of the spines is indicated by the pores in the skin.

In our smallest specimens, the belly is white, the back brown with small white spots, one at the base of each spine; along lower margin of sides are light spots of larger size, enclosed in a network of dusky lines. In slightly larger specimens, the white spots on back have disappeared, and the under parts are covered with a close black reticulum, the lines of which show a tendency to a lengthwise arrangement. This tendency becomes dominant in specimens about 3 cm. long, the lower parts then marked with parallel black lines of varying width and intensity, which occasionally anastomose. The white dorsal spots soon reappear, and the lengthwise streaks begin to fade, wholly disappearing in adults.

We have had for comparison numerous young and adult specimens from the Hawaiian Islands, and two young individuals from Japan. No differences are discoverable, so we have been forced to conclude that *T. hispidus* is identical with *T. erethizon*, and is a species of universal distribution in the tropical Pacific.

293. **Eumycterias punctatissimus** (*Günther*).

Plate XXIII, Fig. 46.

Not rare among the rocky islands in Panama Bay.

The white spots are always numerous and crowded, especially on the lower part of the sides, but they vary considerably in size, and the brown lines forming the network enclosing them are sometimes wider, sometimes narrower. The belly is always white. The sides and top of the head, the nape and the whole dorsal line, are marked with numerous small blue spots, usually surrounded each by a darker ring; the eye is occasionally, but very rarely, surrounded by blue radiating streaks. Young specimens are sometimes marked by an obscurely ocellated dusky area below the dorsal fin, but no trace of this persists in adults. The youngest specimen, 12 mm. long, is a uniform warm brown, without trace of spots. The basal fourth of the caudal fin is usually covered with fine white spots, the remainder of the caudal and all the other fins, translucent, unmarked.

The vertical fins are short, with evenly rounded margins. The pectorals are strongly emarginate, with the upper lobe the longer. The dorsal and anal each contains 9 rays (rarely 10). There is a short nasal tube widely open at the summit.

Family DIODONTIDÆ.

294. **Diodon holacanthus** *Linnæus*.

Three specimens were secured, 115, 179, and 280 mm. long. All show the characteristic black cross-bars and blotches ascribed to this species. Round black spots are also present on the lighter spaces of the back, and on the postocular area, where they are largest. Small black spots are present on the snout in the two smaller specimens, but are lacking in the larger one. In all of the specimens, large black spots are present over the ventral region, one in the axil of each spine. They are more prominent in the youngest example than in the older ones, but their shape is less definite. The fins are immaculate in all, and the upper lobe of the pectoral is notably longer than the lower lobe, a character which becomes more pronounced in the older specimens. So far as our specimens are concerned, there is no indication that with increasing age there is an approach to *D. hystrix*. The species should be held distinct until a full intermediate series is obtained.

Family SCORPÆNIDÆ.

295. **Scorpæna histrio** *Jenyns.*

Taken by the Albatross at Panama (Jordan & Bollman, 1889, p. 182).

296. **Scorpæna pannosa** *Cramer.*

Only the type known; taken by the Albatross at Panama.

297. **Scorpæna mystes** *Jordan & Starks.*

Of frequent occurrence in the Panama market, the collection containing numerous specimens from 10 to 30 cm. long.

In the type of *S. mystes*, the supraocular cirrus is longer than the diameter of the eye, but this is a very variable feature. In the majority of our Panama specimens, the cirrus is shorter than the diameter of the pupil, and in some individuals no trace of it can be found. Two Panama specimens have it long, as in the type; in a third it is long on one side and short on the other. In one adult co-type from Mazatlan, it is short, as is also the case in a young specimen from La Paz, L. C. The variation is dependent on neither age nor sex.

The nearest relative of *S. mystes* is the representative form *S. plumieri* of the Atlantic. The differences alleged to separate the two are slight. In all the specimens we have examined, those from the Pacific can be distinguished by the darker duller coloration, and the wider shallower grooves and pits on the top of the head. *S. plumieri* is currently described as having a long supraocular cirrus. From the following statement, however, it is evident that the species varies in this regard as does its Pacific representative: "Junge individuen besitzen blos wenige, oder selbst keine Hautlappen, und einem jungen Weibchen fehlen auch die tentakeln über dem Auge." (Kner, Novara Fische, 1866, p. 115).

298. **Scorpæna russula** *Jordan & Bollman.*

Dredged by the Albatross at Stations 2795 and 2797, in Panama Bay, 33 fathoms; only the types known.

Family TRIGLIDÆ.

299. **Prionotus xenisma** *Jordan & Bollman.*

Dredged at Albatross Stations 2795 and 2805, in Panama Bay, 33 and 51½ fathoms; the types only known.

300. **Prionotus loxias** *Jordan.*

Only the types known; dredged at Albatross Station 2805, Panama Bay, 51½ fathoms.

301. **Prionotus quiescens** *Jordan & Bollman.*

The types were dredged by the Albatross in Panama Bay, in depths of 7 to 51½ fathoms.

302. **Prionotus albirostris** *Jordan & Bollman.*

The types from Albatross Station 2795, Panama Bay, 33 fathoms.

303. **Prionotus horrens** *Richardson.*

This species is very similar in general appearance to *P. ruscarius*, with which it has been frequently confused. The two agree in having a continuous sharp ridge running from the margin of the snout across preorbital and cheek to the preopercular spine, this ridge bearing several strong bramble-like spines standing out from the head at right angles, and hooked backward. In this respect, both species differ conspicuously from *P. tribulus*, in the adults of which the rostral spine, the spine on the middle of preorbital, and that on the middle of cheek become inconspicuous or wholly wanting. *P. tribulus* cannot be considered a representative Atlantic species of either of these Pacific forms, for the relationship is not so close as has been assumed.

P. horrens seems to be less abundant than *P. ruscarius*. We secured four adults at Panama. Three others have been reported by Jordan and Bollman (1889, p. 182) from Albatross Station 2800, in Panama Bay. Aside from these, the species is known only from the Gulf of Fonseca, where the types were obtained. The following description is drawn from the seven specimens above noted:

Head $2\frac{2}{7}$ to $2\frac{3}{5}$ in length to base of caudal; depth 4 to $4\frac{1}{5}$. Snout equaling maxillary, $2\frac{1}{5}$ to $2\frac{1}{3}$ in head; eye $5\frac{1}{3}$ to 6; interorbital width 4. Dorsal X, 11; anal 9. Snout depressed, the longitudinal profile nearly straight, the sides concave, flaring strongly outwards to the sharp ridge at its lower margin. Beneath the ridge, the surface of the preorbitals is horizontal, continuous with that of the widely exposed dentigerous portion of the premaxillaries, and with the lower surface of the head. The snout is squarely truncate, or the preorbitals, especially in the young, may project slightly beyond its tip. They are never strongly produced, as in *P. ruscarius*, and permit a wide strip of the premaxillaries to be seen from above in the closed mouth.

The interorbital space is wide and flat, bounded by bluntly rounded supraocular ridges, which are usually low, but vary somewhat. This space is never deeply concave, as in *P. ruscarius* and *P. tribulus*.

The head is very finely granular, the radiating ridges delicate and very numerous, the minute granules almost uniformly covering the bones. The anterior margin of the preorbitals is minutely serrulate or granular, the posterior tooth sometimes larger than the others, projecting spine-like. Immediately behind the rounded portion of the preorbital, from which it is separated by a notch, is a strong compressed spine directed outward and backward. Behind this, on the ridge already mentioned, is a series of similar spines increasing in size posteriorly. One of these is on the center of the preorbital, one on the center of the cheek, the third at the base of the preopercular spine. These spines decrease but little with age; but it may be possible that none of our specimens is fully grown. The preocular, supraocular, occipital, nuchal, opercular and humeral ridges and spines offer nothing peculiar. No spines immediately behind the eye. A single pair, similar to the occipital spines, located slightly in advance of the latter, on the blunt postocular ridge. No trace of a postocular groove.

The anterior nostril has a broad short flap arising from its posterior margin. Mouth large, the maxillary reaching a vertical which passes through spine on middle of cheek and traverses the orbit midway between its anterior margin and the front of the pupil. Mandible with a small but evident symphysial knob, much better developed than in *P. ruscarius*, the intermandibular space anteriorly acute. Vomerine and palatine patches of teeth varying greatly in width, the vomerine patch greatly constricted mesially, but not wholly divided in any of our specimens. The vomerine patch about equals in length one of the palatine patches. Gill-rakers varying in length from two-fifths to four-fifths diameter of pupil. They are usually heavy, club-shaped; 6, or rarely but 5 movable ones are developed on horizontal limb of arch. The membrane between the opercular spines is partly covered with cycloid scales.

Scales thin, smooth or weakly ctenoid in the young, wholly smooth with entire edges in adults. The scales of the lateral line have their exposed portions roughened with minute projections, the free edges coarsely spinous in the young. The size and roughness of these scales vary widely in different individuals. The sides of body are wholly scaled, save for a narrow naked strip in the axil of the pectorals and ventrals. The breast is variously scaled, but less completely so than in *P. ruscarius*. The scaled tract is sometimes limited to a narrow medial band, with a constriction opposite the base of the ventrals; when wider than this, it is in adults still bounded in front and on the sides with distinct naked margins. There are 52 scales in the lateral line, and about 100 vertical series above the lateral line.

The dorsal spines are slender and flexible, none of them roughened or serrulate on their anterior margin. The first spine is but little shorter than the second (the longest); the free margin of the fin is slightly concave. The eighth is the last spine to bear movable membrane, the ninth being thick and short, declined, firmly embedded in the integument, and the tenth little more than a conical bony nodule, which is sometimes entirely concealed. The caudal is truncate when spread, rarely slightly emarginate. The pectorals are very short, barely reaching the vent in adults, slightly beyond that point in the young. In the very immature type (115 mm. long), the pectoral is figured as extending to a point opposite the fourth anal ray. The posterior margin of the fin is evenly rounded, the sixth to the eleventh rays the longest. Detached pectoral rays very long and slender, the uppermost about as long as the rest of the fin, extending well beyond tips of ventrals. In adults, the tips of ventrals fall a little short of the tips of the pectorals, and neither fin reaches the vent.

The dorsal contains invariably 10 spines and 11 soft rays; the anal has but 9 rays. As noted above, the last dorsal spine (or tubercle) is sometimes concealed.

Color in spirits: dusky brown above, an obscure broad dark bar extending downwards from anterior part of spinous dorsal, and a second, more distinct, from posterior part of soft dorsal. A dusky shade on cheeks, continued on to lower side of head, where it widens from the cheek spine backward to behind tip of maxillary. Lower parts bright white. Spinous dorsal dusky, especially on its anterior half, where there may be disconnected traces of a distinct black margin. Gill-cavity blackish; peritoneum white.

The soft dorsal has its rays faintly barred, the posterior half darkest, the margin irregularly blackish. Caudal with much white pigment, the terminal fourth with a series of oblong black blotches, occupying the membranes between the rays. The remainder of the fin has two or three irregular cross-series of smaller roundish black spots. The anal is white, some of the rays occasionally margined with black. Ventrals white, sometimes black-margined. Pectorals dusky at base, becoming black toward middle of fin; the distal half is occupied by a conspicuous white cross-bar, beyond which is a narrow bar of black. The white cross-bar does not involve the upper or the lower rays.

Measurements in Hundredths of Length without Caudal.

Total length in mm.	232	213	224	152
Length to base of caudal in mm.	185	171	182	121
Greatest depth	25	24½	24½	28
Least depth	9½	9¼	9	9
Length of caudal peduncle	17	17	17	18
Head	43½	40	40	44
Snout	19½	18	18½	19½
Orbit	7½	7⅓	7½	8½
Interorbital width	11½	10½	10½	12
Maxillary	19½	18	18	20
Greatest width of snout without spine	24	23	23	26
Snout to first dorsal spine	43½	40⅓	40	44
Base of spinous dorsal	23½	21½	20½	23½
Base of soft dorsal	24	24½	26	23
Longest caudal ray	26½	24½	24½	29
Middle caudal rays	24½	22½	22½	26½
Upper pectoral ray	18	18½	17½	20½
Fifth pectoral ray	28	27	25½	29
Ninth (longest) pectoral ray	32	31	29	33
Upper detached ray	31½	30	31	35½
Second detached ray	27	24	24	28½
Third detached ray	21	18½	20	24
Snout to first anal ray	66½	65	64	65
Base of anal	19	20	20½	20½
Ventral spine	14	14	14	16½
Outer ventral ray	19	18	18	21
Inner ventral ray	24	21½	22½	24

304. Prionotus ruscarius sp. nov.

PLATE XXVII, FIGS. 50, 50*a*.

Prionotus horrens JORDAN, 1895 *b*, p. 492 (Mazatlan); JORDAN & EVERMANN, 1898, p. 2172 (Panama; Magdalena Bay); not *Prionotus horrens* RICHARDSON.

Prionotus birostratus JORDAN, 1885, p. 387; JORDAN & HUGHES, 1886, pp. 332, 337; not *Prionotus birostratus* RICHARDSON.

This species strongly resembles *P. horrens*, with which it is found associated. It differs in the coarsely granular head, which is usually strongly birostrate, the concave interorbital space, the strongly ctenoid scales, the more numerous rays in the vertical fins, and in the shape of the pectoral.

Like *P. horrens*, this species has a ridge extending from edge of preorbital backward to base of preopercular spine. The ridge is less sharp than in *horrens*, being scarcely keel-like in our younger specimens, and decidedly rounded in a large individual 34 cm. long. The rostral plates are usually produced into rounded lobes, with a deep emargination between them; but the lobes vary greatly. Where the lobes are large, the premaxillaries are wholly or almost wholly concealed, when viewed from above. In the largest specimen the lobes project but little, and the premaxillaries are exposed.

The ridges and granules are much coarser than in *P. horrens*, more nearly resembling *P. tribulus*. The ridges are everywhere easily discernible. The spines are slightly smaller than in *P. horrens*, but occupy the same positions and are for the most part similarly developed. The supraocular spines are usually smaller, with two present above each orbit, a minute one projecting into a notch in the immediate bony rim of the orbit, and a larger one farther removed from the rim, on the rounded supraocular ridge. But one supraocular spine is present in *P. horrens*. The humeral, opercular and occipital spines and ridges are sharper and stronger in *P. ruscarius*.

Head $2\frac{1}{2}$ to $2\frac{3}{4}$ in length to base of caudal; depth $4\frac{2}{5}$ to $4\frac{3}{4}$; snout $2\frac{1}{5}$ to $2\frac{1}{3}$ in head (to edge of opercular flap); eye $5\frac{1}{3}$ to 6; interorbital width 4 to $4\frac{1}{5}$. Dorsal X, 12; anal 11.

Interorbital space deeply concave, as in *P. tribulus*. Anterior nostril with a slender flap, longer than in *P. horrens*, reaching when depressed to or beyond anterior margin of nostril. The maxillary usually fails to reach vertical from spine on middle of cheek. The intermandibular space is rounded anteriorly; there is little or no trace of a symphysial knob. Vomerine patch of teeth constricted mesially in young specimens, wholly divided into two separate patches in adults. Each half of vomerine patch about equals one of the palatine bands. Gill-rakers 6 (movable), the longest about three-fourths diameter of pupil. The membrane between the opercular spines is covered with cycloid scales.

Scales thick and firm, strongly ctenoid on back and sides, becoming cycloid on belly and breast, and on anterior portion of nape. The scales of the lateral line are less roughened than in *P. horrens*, the edges not strongly spinous. The breast is almost completely scaled, a small tract immediately behind the isthmus, and a narrow area at base of each ventral, naked. There are 50 to 52 scales in the lateral line, and about 100 vertical series above the lateral line.

The dorsal spines are flexible, but stronger than in *P. horrens*. The first and second spines are about equal, the succeeding ones rapidly shortened, the margin of the fin straight. The ninth spine bears a movable membrane. The tenth is immovably imbedded, very strong, the basal tubercle bearing a well-developed, backwardly directed spinous process. The lower caudal lobe is slightly longer than the upper; the margin is concave rather than truncate, when the fin is spread. The pectorals are very short, reaching to or slightly beyond the vent in adults, a little longer in the young. The fin is sharply angulated above, the third and fourth rays the longest; the posterior margin from the fourth to the ninth rays is vertically truncate or slightly emarginate; the whole contrasting strongly with the evenly rounded fin of *P. horrens*. The detached rays are short, the upper not nearly reaching the tips of the ventrals.

The dorsal contains invariably 10 spines and 12 soft rays; the anal has 11 rays in all of the eighteen specimens examined, except in one which had 10.

Color in spirits: dark brown on back and sides, white below; a faint ill-defined dark bar under spinous dorsal, and one slightly more distinct under posterior half of soft dorsal. Gill-cavity blackish. Dorsals translucent, the spinous dorsal blackish toward tip anteriorly; posterior part of soft dorsal dusky at base, the fin with a more or less distinct blackish margin, which does not involve the tips of the rays. Caudal translucent dusky on basal portion, with faint dark blotches arranged in one or two irregular cross-rows. In the terminal third, the rays become charged with much white pigment and the intervening membranes are black. Anal and ventrals translucent, unmarked. Pectorals dusky on basal half, becoming blackish toward middle of fin. The distal half of the third to the ninth rays with a broad whitish bar, broadly margined with black.

This species is now known from Panama, Mazatlan and Albatross Station 3041 (Magdalena Bay, L. C.).

Measurements in Hundredths of Length without Caudal.

Total length in mm	153	225	270	202
Length to base of caudal in mm	119	177	222	157
Greatest depth	25½	22½	20½	24
Least depth	8	8	8	8
Length of caudal peduncle	15	16½	15	14½
Head (to edge of flap)	42	39	36½	40
Snout	19	17½	17	17½
Orbit	8½	7½	7	8
Interorbital width	10½	9½	9	10
Maxillary	18	17	15½	17
Greatest width of snout without spine	25	21½	20	22
Snout to first dorsal spine	41	37½	34½	38½
Base of spinous dorsal	24	23	20½	23½
Base of soft dorsal	24½	27	25	25
Longest caudal ray	27½	28	24½	30
Shortest caudal ray	26	24	21½	26½
Upper pectoral ray	25	27	23	25
Longest (fourth) pectoral ray	33	33	29	33½
Ninth pectoral ray	31	31½	28	32½
Upper detached ray	26	26	23	27½
Middle detached ray	21	22	19	23
Lower detached ray	16	16½	14½	20
Snout to first anal ray	60	58	58	61½
Base of anal	26	26½	25½	25
Ventral spine	14½	14½	13	14½
Outer ventral ray	20	19	17½	20½
Inner ventral ray	28½	25½	23	28

Family GOBIIDÆ.

305. **Philypnus lateralis** *Gill.*

Abundant in the Rio Grande at Miraflores. In life, the scattered spots on the sides and the streaks about eye were reddish in color.

In their List of American Gobiidæ, Eigenmann and Eigenmann (1888, p. 52) distinguish the Atlantic and Pacific species of *Philypnus* (*P. dormitor* and *P. lateralis*) by the size of the scales, the length of the head, and the number of anal rays. In going over this ground later, Jordan and Evermann (1898, p. 2195) state: "The only constant difference between this species [*P. lateralis*] and *Philypnus dormitor* seems to be the brighter coloration of *lateralis*."

We have examined in this connection five specimens of *P. dormitor*, and thirteen specimens of *P. lateralis*. These bear out in the main the differences assigned by Eigenmann. In *P. dormitor*, the head averages shorter, although the extreme of variation includes some measurements of *P. lateralis*. The scales are smaller in *P. dormitor*, although here again there is an overlapping in the formulæ. But in *P. dormitor* the anal rays are constantly 10, while in *P. lateralis* they are constantly 11. Below are data for individual specimens examined:

P. LATERALIS.

	Mazatlan				Panama									
Head	$2\frac{4}{5}$	$2\frac{4}{5}$	$2\frac{4}{5}$	$3\frac{1}{10}$	$2\frac{5}{6}$	$2\frac{5}{6}$	$2\frac{6}{7}$	$2\frac{5}{6}$	3	$2\frac{5}{6}$	$2\frac{5}{6}$	$2\frac{3}{4}$	$2\frac{5}{6}$	$2\frac{3}{5}$
Scales	52	54	55	56	52	56	55	55	54	54	53	56	53	51
Scales in cross-series	......	......	......	......	17	20	19	17	18	17	17	18	16	17
Anal	11	11	11	11	11	11	11	11	11	11	11	11	11	11

P. DORMITOR.

	Havana	Jamaica		Tampico, Mex.	
Head	$3\frac{2}{7}$	3	3+	$3\frac{1}{2}$	$3\frac{1}{2}$
Scales	56	56	59	59	61
Scales in cross-series	19	19	18	21	20
Anal	10	10	10	10	10

We have not sufficient material to enable us to decide whether there are any constant differences in coloration. The young of both species are marked by a longitudinal band, interrupted, or narrowed at intervals by incursions of the ground color. The only young specimen of *P. dormitor* in our possession shows three conspicuous cross-bars on the back: one under posterior portion of spinous dorsal, continued on the fin as a jet-black bar traversing its posterior and distal half; the second, immediately behind the soft dorsal; the third, much narrower, just in advance of the caudal fin. These become faint in adults, but we find traces of them in all our specimens. Where traces of these bars exist in Pacific material before us, they are very faint, even in brightly colored young, and do not involve the spinous dorsal.

306. **Dormitator maculatus** (*Bloch*).

Abundant at the mouth of the Rio Grande. Of the two forms recognized by Eigenmann as occurring in the Atlantic, our material agrees almost exactly with the second, which he had from Gurupa and Rio Grande do Sul.

Our younger specimens, 10 to 15 cm. long, are slender, with the upper profile usually noticeably depressed above the eyes. The head is 3 to $3\frac{1}{6}$ in the length, the depth $3\frac{2}{5}$ to $3\frac{1}{5}$. Highest anal ray $1\frac{2}{5}$ to $1\frac{1}{5}$ in head. Distance from snout to base of first dorsal spine equaling distance from first dorsal spine to base of last anal ray; it is sometimes slightly greater, sometimes slightly less than this distance, but always approximates it.

The color was light grayish, with numerous oblique dark bars running downward and forward from the back. A blue spot surrounded by a black area above the base of the pectoral. Base of pectoral with a blue or black cross-bar. A dark bar downward from eye to angle of mouth, and four parallel longitudinal dark streaks across cheeks and opercles. The spinous dorsal was broadly edged with bright red in life.

Two adults, 255 mm. long, have the depression above the eyes less marked, the head larger, $2\frac{3}{4}$ in length, the depth much greater, $2\frac{2}{3}$ in length, and the coloration plain dark brown on body and fins, save the red margin to the dorsals. Distance from snout to base of first dorsal spine equals distance from the latter to base of third anal ray.

It is probable that this widely-distributed brackish-water species is subject to local variations in different parts of its range, variations which are not geographically progressive and are incapable of systematic recognition. According to this view, the resemblance of the Panama and Rio Grande do Sul specimens is a chance one, depending upon independent local variation from the common stock.

A number of small specimens from the Rio Presidio at Mazatlan, Mex., do not agree precisely with either form, though they stand nearer the one here described. But the head averages somewhat smaller ($3\frac{1}{6}$ to $3\frac{1}{2}$ in length), and the distance from snout to first dorsal spine is about equal to that between first dorsal spine and middle of anal. There seems to be no basis for the division of these specimens into three groups, as indicated by Jordan and Evermann (1898, p. 2197).

307. **Eleotris pictus** *Kner & Steindachner*.

Eleotris æquidens JORDAN & GILBERT, 1881*f*, p. 461.

Abundant in muddy overflow ponds and ditches at Miraflores, where a few specimens were obtained. These agree perfectly with Kner and Steindachner's description and figure, also with typical *E. æquidens* from Mazatlan. Both show the characteristic mottlings of white or bluish white on the under side of the body. The black bars on the sides of the head are not visible in the larger individuals, but are very apparent in young specimens 50 to 125 mm. long. They consist of a short narrow line on each side of occiput, more or less broken up into series of dots, and of two rather broad dark bars diverging backward from eye. The upper bar extends to the upper end of the pectoral base, but is not well marked posteriorly. The lower runs backward and slightly downward across cheeks to the preopercular margin. The lower part of cheeks is crossed nearly vertically by three broad dark shades separated by two narrow light streaks. In none of our specimens, do we note the bar described by Kner and Steindachner beginning at the angle of the mouth and joining the second bar at preopercular margin. All of the fins are dark, rather finely barred with blackish and lighter. The spinous dorsal has usually a rather wide translucent margin, and a submedial lengthwise translucent streak.

The teeth are equal or nearly so. In young specimens, a slight enlargement of the outer mandibular teeth can often be detected.

In specimens of *Eleotris pisonis* from Havana (Rio Almendares), the outer series in the upper jaw are slightly enlarged, more noticeably on the sides than in the front of the jaw. A few of the posterior teeth near the middle line of the upper jaw are also slightly enlarged. In the medial portion of the mandibles, the anterior row is slightly larger. The inner mandibular series is also enlarged, the teeth increasing in size laterally where the band narrows to a single series.

In *E. abacurus*, the teeth are similar to those of *E. pisonis*, but the canines are much larger. Both outer and inner series are enlarged in the upper jaw, the inner series less so, and the teeth are declined. It is extremely probable that *E. abacurus* is a synonym of *E. amblyopsis*.

308. **Alexurus armiger** *Jordan & Richardson.*

A single specimen, 172 mm. long, slightly larger than the type. This is the second individual to be reported, and extends the known habitat of the species from La Paz, L. C., to Panama.

The type description needs modification in the following respects: The diameter of the eye is contained $9\frac{1}{2}$ times, the length of the snout 5 times in the length of the head. There are broad bands of villiform teeth in each jaw, the outer series enlarged to form small canines. In the upper jaw, these increase in size laterally, and extend as far as does the villiform band. The inner teeth are not enlarged. In the mandible, the outer canines are confined to the central portion of the jaw, numbering only about 5 on each side of the symphysis. The teeth of the inner mandibular series are also enlarged, but less so than the outer, and are directed backward.

The cheeks and opercles are wholly covered with cycloid scales similar to those on the occiput. They do not overlap, and are more or less embedded and concealed.

As indicated in the published drawing of the type (Jordan, 1895 *b*, Pl. XLVIII), the rays of the procurrent portion of the caudal fin are unbranched and not articulated.

In the Panama specimen, the fin rays number: dorsal VI, 14, anal 11.

309. **Gymneleotris seminudus** (*Günther*).

Only the type known from Panama.

310. Gobius soporator *Cuvier & Valenciennes.*

The most abundant fish of the tide-pools among the rocks.

311. Gobionellus sagittula (*Günther*).

Not seen by us; the species was described from specimens taken on the Pacific Coast of Central America, and has been recorded from Panama Bay by Jordan (1885, p. 387) and by Boulenger (1899, p. 3; Rio Tuyra, Darien).

312. Gobionellus microdon (*Gilbert*).

PLATE XXVIII, FIG. 51.

This species has been known hitherto from two immature specimens taken in a brackish lagoon a short distance south of Guaymas, in the Gulf of California. We now report it from the Panama region, where two specimens were secured in the Rio Grande, at Miraflores, a point entirely above the action of the tides. One specimen is immature, only slightly larger than the types, the other is 113 mm. long, apparently adult. These enable us to correct the original account of the species in respect to the dentition and the coloration.

The teeth are minute in both jaws. Those in the mandible are in a narrow band, with the outer series very slightly enlarged, inserted on the extreme outer edge of the jaw, and directed almost horizontally. They are not separated by an interspace from the rest of the band. Those in the upper jaw are extremely minute, in a wider band than those in the mandible, the outer series stronger than the others, but scarcely longer. Here again, there is no interspace between the stronger series and the rest of the band. In *G. sagittula*, the upper jaw contains an outer series of strong conical teeth, separated by a well-defined interspace from a narrow inner series of small villiform teeth; the villiform band in mandible is somewhat wider, of slightly coarser teeth, with an outer series less enlarged, and with two or three pairs of strong conical teeth in the inner series next the symphysis.

Color in spirits: light greenish olive, the snout and interorbital region brownish; a narrow black streak extending backward from eye; a second narrowly V-shaped streak on opercle. A series of five to seven vertically oblong blotches or bars on middle of sides. In the young specimen, these are distinctly band-like, and reach nearly to upper and lower profiles of body. In the adult, they are much shortened, and the anterior ones are obscure. Alternating with these bars above, is a series of blotches extending half way to middle line of sides, becoming confluent in the dorsal region with a brown reticulum which encloses variously-shaped areas of the ground color. A series of three brown blotches occupies the naked predorsal strip.

Dorsals whitish, each with three or four irregular lengthwise streaks, slightly looped from ray to ray. The caudal has a number of narrow cross-bars composed of series of small spots on the membrane. Other fins are colorless, or nearly so. A bright green spot is on the base of the tongue in life.

Measurements in Hundredths of Length without Caudal.

Total length in mm.	87
Head	23½
Snout	6½
Maxillary	10
Eye	5
Interorbital width (bony)	2¼
Depth	19
Depth of caudal peduncle	9
Distance from snout to dorsal	31
Distance from first dorsal spine to first ray	19
Base of second dorsal	39
Snout to anal	55
Base of anal	37
Highest dorsal spine	24
Length of caudal	34
Length of pectorals	21½
Length of ventrals	21
Transverse rows of scales	65
Dorsal spines	VI
Dorsal rays	14+1
Anal rays	14+1

313. **Garmannia paradoxa** (*Günther*).

PLATE XXVIII, FIG. 52.

Abundant in tide-pools on the Panama reef, where numerous specimens were obtained.

Females are light olivaceous in color, with nine or ten dark cross-bars, two of which are on head, one opposite base of pectorals, two under spinous dorsal, three under soft dorsal, one on caudal peduncle and sometimes a fainter one at the base of the tail. The bars are usually wider than the interspaces, and each contains a number of small spots of the light ground color, arranged in one or more vertical series. A narrow horizontal black line traverses each bar at middle of sides. The dorsals are coarsely speckled, the caudal finely barred. The anal is blackish, the pectorals and ventrals faintly dusky; a small blackish blotch is sometimes present at base of upper pectoral rays. The under side of the head is coarsely spotted, usually with two parallel cross-bars. Males are much darker, sometimes nearly uniformly blackish, with all the fins black.

Six spines have been erroneously attributed to this species. Seven are present in all specimens examined by us, including the one obtained by the Hopkins Expedition to Mazatlan (see Jordan, 1895, p. 497, Pl. LIX). The normal fin-formula is dorsal VII, 12; anal 10. In ten specimens counted, one had 11 dorsal rays and one had 13; in all others, the normal formula was found. The first dorsal spine is constantly produced into a filament, which usually fails to reach the middle of the soft dorsal, but extends beyond the first dorsal ray.

The dentition has not been correctly described. There is in the upper jaw a moderate band of villiform teeth, along the front of which is a series of strong curved canines, which decrease in size regularly toward the angles of the mouth. Behind the band, in the middle of the jaw, are four much slenderer canines, directed backward, all evenly spaced. In the lower jaw, the teeth are in a villiform band, with an outer and an inner series of strong canines. Laterally, these all give place to a single close-set series of teeth, which are but little larger than those of the villiform band. The canines of the inner series increase in size laterally and are directed obliquely backward. The outer canines are stronger than the inner, and decrease in size laterally.

The scales are large and strongly ctenoid, covering the body behind the vertical from the second to fourth ray of second dorsal. There are about 16 cross-series of scales, the anterior series containing about 12 scales each.

The head is contained $3\frac{1}{3}$ in the length to base of caudal; $4\frac{1}{6}$ to $4\frac{1}{4}$ in the total length.

314. Enypnias seminudus (*Günther*).

PLATE XXIX, FIG. 53.

Fifteen specimens were secured of this rare species, which had not been reported since the discovery of the types in 1861. Examination of our material shows that the species is widely separated from typical *Gobius*, and also from *Garmannia*, possessing the following characters:

The dorsal spines are constantly 7 in number instead of 6, the number assigned in current descriptions. There is a pair of thick barbels on the chin, each of which springs laterally from the edge of the median frenum of the lower lip. The body is much more completely scaled than is the case with *Garmannia paradoxa*. The belly is naked, and has continuous with it a naked strip extending up into the axil of the pectoral fin. The head and nape are also naked, a narrow naked strip extending backward along base of spinous dorsal. Otherwise, the scales cover the body, the scaly area narrowing anteriorly behind the base of the pectoral fin. Anteriorly, the scales are very small and are arranged irregularly. They increase in size posteriorly, and are there inserted in regular series. There are about 50 or 60 scales in a line along middle of sides.

In this species, as in *Garmannia paradoxa*, we fail to find the "2 small curved canine teeth on each side of lower jaw." The mandible contains a broad band of rather coarse villiform teeth, with an inner and an outer series of enlarged canines. The upper jaw is similar, but contains no enlarged inner series.

None of the dorsal spines are filamentous or elongate. They are constantly seven in number, the last two much more widely spaced than the preceding five. The last membrane joins the base of the first soft ray.

The head is large, with swollen cheeks and a blunt nose. Its length is contained $3\frac{1}{5}$ to $3\frac{1}{4}$ times in length to base of caudal, $3\frac{3}{4}$ to $3\frac{4}{5}$ times in total length. The greatest depth of body is contained $4\frac{1}{5}$ times in length to base of caudal, $5\frac{1}{6}$ in total length, in a female; $4\frac{2}{3}$ ($5\frac{2}{3}$) in a male.

In females, the body is obscurely cross-banded, a horizontal black line on each bar along dorsal outline, and another where each crosses middle line of sides. The soft dorsal and caudal are coarsely speckled in cross-series; a black bar at base of upper and one at base of lower caudal rays. A conspicuous black blotch at base of upper pectoral rays. Males are much darker than females, the fins all blackish and without cross-barring, the bars on sides little evident.

The normal fin-formula is D. VII, 15; A. 11. In fifteen specimens examined, all contained 7 dorsal spines, thirteen contained 15 dorsal rays (one had 12, and one 16 rays), fourteen contained 11 anal rays (one had 10 rays).

There is nothing in the squamation to distinguish this species generically from *Gobius*. The genus *Enypnias* may be based upon the 7 dorsal spines and the pair of mental barbels.

315. **Bollmannia chlamydes** *Jordan.*

Only the types known, from Albatross Stations 2800, 2802, 2803, 2804, 2805, Panama Bay, depths 7 to $51\frac{1}{2}$ fathoms.

316. **Aboma lucretiæ** (*Eigenmann & Eigenmann*).

Only the type known, from Pearl Island, Bay of Panama.

317. **Microgobius emblematicus** (*Jordan & Gilbert*).

Microgobius cyclolepis GILBERT, 1891, p. 74.

About thirty specimens were secured in tide-pools on the Panama reef.

In spirits, the coloration is largely lost, the fish having the translucent olivaceous cast so characteristic of the typical members of this genus. On the back, along the base of the dorsal fins, are more or less distinct traces of five elongate dusky blotches, the intervals between which are narrower than the eye. Most specimens show a distinct, vertically oblong black humeral spot. The fins are translucent dusky, darker in males, in some of which the ventrals and anal are black. The spinous dorsal has occasionally one, or several, lengthwise series of small dark spots, one for each spine. The red streak on caudal is often represented by a pale line traversing obliquely the dusky fin. For the coloration in life, we can refer to the original description.

The species varies greatly in depth, in squamation, and in the length of the dorsal spines. The depth varies from 4$\frac{4}{5}$ to 6 in length to base of caudal. The scales grow larger posteriorly, and are there regularly arranged. More anteriorly, they are reduced in size and crowded, and are very difficult to enumerate. Different specimens vary greatly in size of scales, in amount of crowding and irregularity in the anterior part of the body, and also in the relative completeness with which the anterior part of the body is invested. The head, nape, and belly, and a strip along base of spinous dorsal are always naked. A narrow vertical strip immediately behind pectorals is usually scaleless. The scaly area of sides therefore narrows anteriorly and ends at a point about opposite the first dorsal spine. In some specimens the scales cease more posteriorly, opposite fourth or fifth dorsal spine. This condition does not differ essentially from that found in *Microgobius signatus*, the type of the genus, nor in *M. thalassinus*. The genus *Zalypnus*, based on *emblematicus*, must therefore be withdrawn. As above indicated, the enumeration of the rows of scales is attended with great difficulty, and cannot be made with any high degree of accuracy. In different specimens, our counts have varied from 45 to 70, the majority ranging between 55 and 65.

The third, fourth and fifth dorsal spines are usually somewhat produced, often extending to middle of dorsal base, or even beyond this point. In some specimens, apparently females, the fin is evenly rounded in outline, with none of the rays produced. *Microgobius cyclolepis* was based on a specimen, 5 cm. long, from the Gulf of California, said to differ from *M. emblematicus* in the lower spines, the larger scales, and in the presence of a round black humeral spot. Our present material shows that all of these characters fall within the range of variation of *M. emblematicus*, of which *M. cyclolepis* is doubtless a synonym.

The dentition is as follows: The upper jaw is provided with an anterior series of slender canines extending along the proximal half only of each premaxillary. Those nearest the center of each jaw are upright, backwardly curved toward their tips; the others are strongly curved (almost hooked) in the direction of the angle of the mouth. Behind the canines is a single series of minute villiform teeth, extending much farther laterally than do the canines. The mandibular teeth are arranged like those in the lower jaw, the outermost canine on each side larger than the others. Opposite the point where the anterior series terminates, the teeth of the posterior row are abruptly transformed into laterally curved canines, which replace on the sides of the jaw those of the anterior row.

In ten specimens, the fin-formula is as follows, the last ray of both dorsal and anal divided to the base and enumerated as one ray:

	Dorsal spines	Dorsal rays			Anal rays		
Number of rays.........	VII	16	17	18	16	17	18
Specimens	10	1	6	3	1	7	2

One specimen with 18 rays in the dorsal has 17 in the anal. In all other cases the two fins agree. All specimens possess a sharp thin dermal fold which extends from the first dorsal spine, to the base of which it is attached, forward over nape and occiput to a point immediately behind the eyes. A similar fold exists in *M. signatus*, and will doubtless be detected in *M. thalassinus*. It does not exist in *M. gulosus*, which is in other respects less closely allied to the species under consideration, and will doubtless in time receive generic recognition. A similar fold is found in *Gobius nicholsi*, and again, in an exaggerated form in *Lophogobius cyprinoides*.

M. emblematicus is most nearly allied to *M. thalassinus*, which it seems to represent in the Pacific. No structural features which promise to be permanent are alleged to distinguish them, but we have no specimens of *thalassinus* at hand for comparison. It seems altogether probable that *M. eulepis*, from Fortress Monroe, is a synonym of *M. thalassinus*.

Measurements in Hundredths of Length without Caudal.

Total length in mm	48	50
Length to base of caudal in mm	38	40
Head	27	26½
Snout	5½	5½
Eye	7	7½
Interorbital width	1½	2
Maxillary	12	14
Depth of body	21	17
Depth of caudal peduncle	10	10
Longest dorsal spine	16	43
Longest dorsal ray	12	17
Longest caudal ray	26	28
Longest pectoral ray	18	18
Longest ventral ray	21	21

318. **Microgobius miraflorensis** sp. nov.

PLATE XXIX, FIG. 54.

A species with comparatively large ctenoid scales, with produced spinous dorsal, and with plain coloration. Resembling in general appearance *M. emblematicus*, but the body less elongate, the mouth larger, the caudal more produced, the scaling and the coloration entirely different. There is also lacking the cutaneous fold on nape and occiput.

Head 3⅓ in length; depth 5. Maxillary 1⅔ in head; eye 3½. Dorsal VII, 17. Anal 17; the last ray split to the base, the two halves separated for half the distance found between distinct rays.

The body is rather elongate, the mouth large, oblique, the maxillary reaching slightly beyond the vertical from the posterior margin of the orbit. The interorbital space is very narrow and shallowly grooved, its width but half the diameter of the pupil. The gill-opening is produced below the level of the pectoral base. There are no fleshy appendages on the inner edge of the shoulder girdle.

The teeth are in a double row in each jaw, those of the outer series enlarged to form slender curved canines, as in other species of *Microgobius*. The outer series is confined to the anterior portion of each jaw, the inner series extending laterally beyond them. In the mandible, these lateral teeth are somewhat enlarged, replacing those of the outer series, which they do not equal in size.

The spines of the dorsal fin are all very slender and flexible, all but the first and seventh produced, but connected by membrane to their tips, the tip of the produced lobe reaching middle of soft dorsal when depressed. Soft dorsal and anal of equal extent, high, the last rays slightly overlapping the caudal. Pectorals and ventrals reach the same vertical, which is slightly behind the origin of the anal fin. The caudal fin is lanceolate, the middle rays produced, their length equaling the distance between the tip of the snout and the base of the middle pectoral rays.

The scales are large, all but the anterior ones regularly arranged and strongly ctenoid. Anteriorly, in the post-pectoral region, the scales become reduced in size, cycloid, and less regularly arranged. As nearly as they can be enumerated, there are 44 or 45 in a longitudinal series. The head and nape, a narrow strip along spinous dorsal, and the breast and belly are naked.

There were no bright colors in life, while in related species (except *gulosus*) there are blue, green and red. In spirits, the head and body are light grayish olive, with a soiled appearance due to minute punctulations and the faintly darker margins of the scales. The snout, and the marginal portions of the vertical fins, are more distinctly dusky. The sides are crossed by a number of extremely narrow dark lines, 4 or 5 of which can be counted on that part of sides corresponding to anterior halves of dorsal and anal. A more distinct narrow bar descends from the front of the spinous dorsal. Pectorals and ventrals colorless.

Measurements in Hundredths of Length without Caudal.

Total length in mm.	39
Length to base of caudal in mm.	29
Head	29
Depth	21
Depth of caudal peduncle	8
Maxillary	17½
Eye	8
Interorbital width	2
Snout to first dorsal spine	35
Base of first dorsal	17
Base of second dorsal	38
Snout to origin of anal	54
Base of anal	37
Length of caudal	33
Length of pectoral	23
Length of ventral	25
Longest dorsal spine	39

319. Evermannia zosterura (*Jordan & Gilbert*).

Seven specimens were secured from the tide-pools of the Panama reef, where it was associated with the much more numerous *E. panamensis*. The species had been detected heretofore only at Mazatlan, Mex. In the Panama specimens, the normal fin-formula is D. IV, 14+1; A. 13+1. One specimen only varies from this in having the anal rays 14+1. In seven additional specimens from Mazatlan no variation exists.

E. zosterura agrees with *E. panamensis* in having a rather long flexible appendage to the shoulder-girdle, and in the presence of embedded scales; though both characters are denied in all published descriptions. The scales are very few in number, and can be detected only by the examination of detached portions of the skin under high magnification. There are thus no characters remaining to separate *Evermannia* from *Hypnus*, save that the latter has five instead of four dorsal spines, with none of them filamentous or produced; the scales are also regularly arranged and are not concealed. These characters seem doubtfully sufficient for generic division, but the groups may be provisionally retained pending further examination of allied species. *Clevelandia* is somewhat less closely related. It is said to have no fleshy appendages to the shoulder-girdle, but in *C. ios*, which we have re-examined, there is an evident low sharp crest along the lower portion of the girdle, rising at about two points to form inconspicuous papillæ. This condition is quite different from that obtaining in *Evermannia* and *Hypnus*, where a single long flexible finger-like process arises from the same locality in all of the species.

Measurements in Hundredths of Length without Caudal.

	♂	♀
Length of body in mm.	22	30
Length of head	33	32
Length of snout	6	7
Length of maxillary	15	13½
Diameter of orbit	5½	6 +
Depth of body at ventral base	20	18
Distance from snout to spinous dorsal	42	43
Base of second dorsal	35	34
Distance from snout to anal	59	61
Base of anal	32	27
Length of pectoral fin	16	16½
Length of ventral fin	23	22
Length of caudal fin	26½	24

320. Evermannia panamensis sp. nov.

PLATE XXX, FIG. 55.

Head 3⅙ in length, depth 5½. Dorsal IV, 16; anal 14; pectoral 19.

Body slender, highest opposite base of ventrals, which in preserved specimens protrude much below the general contour of the belly. The body tapers comparatively little posteriorly. The upper profile descends in a long even curve from the front of the dorsal to the tip of the snout, with an indentation in front of occiput. The lower jaw is curved upward toward tip, well included within the upper. The teeth are minute, slender, and slightly curved; in a narrow band on the extreme edge of each jaw, growing wider in front; the outer series is slightly enlarged. The maxillary extends beyond the orbit for a distance about equal to its diameter; its posterior extremity slightly behind the middle of the head. The eyes are small, 6½ in head, separated by a narrow space which is less than half their diameter.

The edge of the shoulder-girdle has one rather long flexible appendage, inserted opposite the fourth to sixth pectoral ray counted from below.

The first dorsal spine is filamentous in the male, extending in the type specimen to base of ninth soft ray, when depressed. The second spine is also somewhat produced, reaching in the type to slightly beyond the base of the second soft ray of dorsal. The third and fourth dorsal spines are shortened, but extend slightly beyond base of first soft ray. The first three spines are close-set and evenly spaced; the fourth is more widely separated from the third, the interval about equaling that separating the first from the third spine. The distance between the base of the fourth dorsal spine and the origin of the second dorsal equals the length of the snout. In females the first spine is usually produced, but less so than in males. In some specimens it fails to reach the base of the first soft ray.

The origin of the anal is opposite the interspace between the third and fourth dorsal rays. Its last ray is slightly posterior to the last dorsal ray. The last rays of the dorsal and anal overlap the base of the caudal. The caudal is produced, lanceolate, its length four-fifths that of head. Scales small, cycloid, partially embedded, not easily distinguishable.

Color in spirits: males dusky brown, somewhat lighter toward middle line of belly, the pigment dots on head much coarser and more widely spaced than those on sides of body. A faint vertical dark line below the eye. Pectorals, ventrals, dorsals, and upper half of caudal fin translucent, with dusky rays. Anal black, its upper half translucent, strongly contrasting. In life the upper half of caudal was yellow.

The females are lighter and less uniform in coloration. The ground color is light olive, the upper part of head and the dorsal region finely mottled with brown, the sides of body with narrow streaks following the lines which separate the myotomes. The dorsal fins have translucent membranes, and almost uniformly dusky rays. The caudal has the upper half plain or faintly cross-banded, the lower half translucent or faintly shaded, the coloration of the two halves never sharply distinguished as in the male; there is a faint submarginal dusky streak, better defined on upper half of fin; the margin is narrowly translucent or whitish. The basal two-thirds of anal fin is dusky, more intense toward middle of fin, the marginal third translucent or whitish. The pectorals and ventrals are translucent, the former with dusky rays, the latter unmarked.

This species is closely related to *E. zosterura*. It is more extensively scaled than the latter, and seems to attain a larger size. It has one or two more soft rays in the dorsal and anal fins. The male is readily distinguished by its striking and peculiar coloration. The females require careful inspection, but can be separated usually at sight by the coloration of the second dorsal fin, which is noticeably speckled in *E. zosterura*.

Forty specimens of this species were obtained in tide-pools on the Panama reef.

Measurements in Hundredths of Length without Caudal.

	♂	(Type) ♂	♀	♀
Length without caudal in mm.	35	32½	31	32½
Length of head	33	33½	32½	32
Length of snout	8	7½	7	7
Length of maxillary	17½	17	15	13½
Diameter of orbit	5	5½	6	6
Interorbital width	1½	2	1½	1½
Depth of body at ventral	17½	17½	17	18
Least depth of caudal peduncle	8	8	7½	7½
Distance from snout to spinous dorsal	43	44	42½	41½
Distance between front of dorsals	15	16	16½	16½
Base of second dorsal	35	34½	35½	36
Distance from snout to anal	60	61	64	62
Base of anal	31	30	27	30
Length of caudal peduncle	10	10	8½	8
Height of longest dorsal spine	30	38	16	15½
Length of pectoral fin	14	16	16½	15
Length of ventral fin	19	23	22	21
Length of caudal fin	25	27	26	24

321. **Tyntlastes brevis** (*Günther*).

This species is known from the type, and from two partially digested specimens taken from the stomach of a *Centropomus* (Gilbert, 1890*b*, p. 451).

Family ECHENEIDIDÆ.

322. **Echeneis naucrates** *Linnæus.*

Recorded from the Gulf of Panama by Boulenger (1899, p. 3).

323. **Remora remora** (*Linnæus*).

Obtained at Panama by Gilbert (Jordan, 1885, p. 372); not seen by us.

Family OPISTHOGNATHIDÆ.

324. **Opisthognathus punctatum** *Peters.*

Recorded from Panama by Jordan (1885, p. 389) on specimens secured by Gilbert; not seen by others.

Family DACTYLOSCOPIDÆ.

325. **Dactyloscopus zelotes** *Jordan & Gilbert.*

Only the type known, collected at Panama by Captain J. M. Dow.

Family URANOSCOPIDÆ.

326. **Kathetostoma averruncus** *Jordan & Bollman.*

Known from the type, dredged in Panama Bay at Albatross Station 2800, in 7 fathoms (Jordan & Bollman, 1889, p. 163). Recorded by Garman (1899, p. 75) from depths of 56 to 210 fathoms.

Family BATRACHOIDIDÆ.

327. **Batrachoides pacifici** (*Günther*).

Very abundant at Panama, appearing daily in the markets; the young abundant in the tide-pools of the reef. The youngest specimen obtained by us is 24 mm. long, and shows a well-developed adhesive disk between the ventral fins. In a specimen 30 mm. long, no trace of the disk remains. In the young, the ground color is much lighter than in adults, while the black cross-bars on body and fins are much more conspicuous.

In their account of this species, Meek and Hall (1885, p. 61) make two serious errors, which are repeated by Jordan and Evermann (1898, p. 2314). The scales are said to be ctenoid, whereas they are perfectly smooth, with entire edges; and the anterior mandibular teeth are described as in two rows, while they are in a cardiform band, some or all of the outer and the inner series enlarged as strong conical canines. In the outer row there seem to be regularly two or three pairs of these canines.

The upper lateral line is interrupted under the middle of the soft dorsal, the lower line at a point slightly posterior to this: the two are then continued at the immediate base of dorsal and anal respectively, and are again interrupted near the ends of these fins, to reappear on caudal peduncle at their former levels; they are discontinued on the base of the caudal fin, but are each represented on the fin itself beyond the base by a series of two or three pores.

The smaller number of fin-rays and the much larger eye serve readily to distinguish this species from *surinamensis* and *boulengeri*. In dentition, it seems to agree more nearly with the latter.

Measurements in Hundredths of Length without Caudal.

Length to base of caudal in mm	208	235
Length of head	38	38½
Greatest width of head	32	33
Length of snout	8	8½
Diameter of eyeball	6	5½
Interocular width	8	10
Length of maxillary	20½	22½
Greatest depth of body	18	17
Depth of caudal peduncle	7½	7½
Snout to first dorsal spine	35½	37
Base of second dorsal (to base of last ray)	51	51
Snout to front of anal	55	58½
Base of anal (to base of last ray)	42	40
Length of caudal	18	17
Length of pectoral (from middle of axil)	18	17
Length of ventral	15	15

328. **Batrachoides boulengeri** sp. nov.

PLATE XXXI, FIGS. 57-57a.

Batrachoides surinamensis GÜNTHER, 1861 *b*, p. 174 (in part); GÜNTHER, 1868, p. 388. Not *Batrachus surinamensis* BLOCH & SCHNEIDER (Surinam).

Head $2\frac{2}{3}$ to $2\frac{4}{5}$ in length; greatest width of head $3\frac{2}{7}$; depth $5\frac{4}{5}$. Interorbital width $2\frac{4}{5}$ to $2\frac{5}{6}$ in head; snout $4\frac{1}{4}$; maxillary $1\frac{3}{4}$ to $1\frac{4}{5}$ in head. Eye $3\frac{2}{3}$ to 4 in interorbital width, 10 to 11 in head. Dorsal III, 27 to 29; anal 25 or 26.

Head very strongly depressed, the posterior part of trunk strongly compressed, the depth and width about equal at a point opposite the tip of the pectoral fins. The arrangement of pores and barbels on the head is essentially as in *B. pacifici*, but the filaments are more numerous and larger. As in other species, the filaments are clustered, being for the most part the fringed margins of cutaneous flaps which occur in pairs on either side the organs of the lateral lines.

The teeth near mandibular symphysis are in a broad cardiform patch, with the outer series enlarged to form broad conical canines. The sides of the mandible are occupied by a single series of very strong conical canines, two or three of which near the middle of each ramus are much larger than those in front and behind; this series is continuous with the posterior series of the cardiform band, where they decrease rapidly in size, those nearest the symphysis being scarcely larger than the others of the band. Vomerine teeth normally eight in number, the median ones small, the others increasing rapidly, the outermost usually as large as the largest of the palatine series. Palatine teeth strictly in a single series, eleven in number on each side; they increase regularly from the anterior end backward to the sixth, which is the largest, the remaining five being subequal, and about as large as the third.

The premaxillary teeth are all finely villiform, in a narrow band which tapers laterally to a point, and is discontinued opposite the fourth or fifth of the palatine series. Opercle and subopercle each with two strong diverging spines, the lower in each case shorter than the upper.

The entire head, with the throat and breast and the pre-pectoral area are naked. The rest of the body, including the entire belly, is covered with elongate imbricated cycloid scales, the margins of which may be slightly crenate. As in other species of the genus, there are two lateral lines: the upper begins on a level with the upper opercular spine, runs parallel with the back for a distance slightly exceeding two-thirds the length of the trunk, to a point opposite the base of the eighteenth dorsal ray; it is there discontinued, to reappear at the extreme base of the dorsal fin, along which it is evident from the twentieth to the twenty-fifth ray; it is there again interrupted, reappearing at its former level, where it is continued to a point opposite the end of the dorsal fin. The lower lateral line curves around the lower base of the pectoral fin and up behind it, then runs nearly parallel with the base of the anal to its interruption at a point opposite the twelfth anal ray; it is then continued along the base of the anal to within a few rays of its end, when it reappears at its former level. Two short longitudinal series of filaments divide the basal portion of the caudal fin into thirds, and seem to represent a posterior continuation of the two lateral lines.

There is a deep glandular pocket behind the upper portion of the pectoral fin. On the inner face of each pectoral toward the base is a series of grooves, one in each interradial membrane; these are continued proximally as canals which penetrate the base of the fin.

The color is gray, very finely mottled with olive-brown. About seven dark bars cross the back and sides. The belly and under side of the head are whitish. The ventrals are whitish, the other fins colored like the body.

This species seems to resemble the Atlantic *B. surinamensis*, with which it has been identified by Dr. Günther. No specimens of *surinamensis* are at hand for comparison, but published descriptions indicate important differences between the two forms. According to Cuvier and Valenciennes (Hist. Nat. Poiss., Vol. XII, p. 488), *B. surinamensis* has a very small eye, the diameter of which is contained eight or ten times in the interorbital space; the palatine teeth are in two rows, the throat is scaly, and the two lateral lines disappear near the middle of the length of the trunk. Meek and Hall (1885, p. 61) state that the vomerine teeth are small, about fourteen in number, and the pectoral is without pores on its inner surface. All of these features are essentially different in the species here described, as has appeared in the above description. Authors are not agreed concerning the arrangement of the palatine teeth in *B. surinamensis*. They are variously described as in two rows, in one irregular row, or in a single series. We are also uncertain concerning the anterior mandibular teeth; Cuvier states that those of the anterior series of the cardiform band are stronger than the others, while Günther describes a villiform patch, the outer teeth of which are not canine-like.

Through the courtesy of Dr. C. H. Eigenmann, we are enabled to give the following notes on the specimen of *B. surinamensis*, on which Meek and Hall based their account of the species. The specimen is 111 mm. long. It is numbered 2080 in the catalogue of the Indiana University Museum.

The longitudinal diameter of the eye is one-third the interorbital width. The palatine teeth are conic, irregular in size, in a single row. The vomerine teeth are 14 in number, increasing in size outward. The mandibular teeth are in a single series laterally, in a band in front, the anterior and the posterior series of the band evidently enlarged. Upper jaw with a narrow band, the posterior row slightly enlarged. Region in front of ventrals naked. Lateral lines disappearing near middle of tail. No pores at base of pectoral rays on inner surface.

Measurements in Hundredths of Length without Caudal.

Length to base of caudal in mm.	295	255
Length of head	35½	36
Greatest width of head	29	31½
Length of snout	8½	8½
Diameter of eyeball	3½	3½
Interocular width	12½	13
Length of maxillary	20½	21
Greatest depth of body	16	18
Depth of caudal peduncle	7	7
Snout to first dorsal spine	35	35½
Base of second dorsal	55	56
Snout to front of anal	50	50
Base of anal	47	49
Length of caudal	16	18
Length of pectoral from axil	16	17
Length of ventral	13½	15
Base of caudal to bend in upper lateral line	22	19
Base of caudal to bend in lower lateral line	27	22

329. **Porichthys margaritatus** (*Richardson*).

Taken by the Albatross in Panama Bay at Station 2802, at a depth of 16 fathoms. Also reported by Dr. Boulenger (1899, p. 3) from Rio Tuyra, Darien (as *P. notatus*).

330. **Porichthys greenei** sp. nov.

PLATE XXX, FIG. 56.

A small light-colored species, taken by us in the tide-pools of the Panama reef. It differs from all other species of the genus in the complete union of the dorsal and anal fins with the caudal, in the small head, and in the comparatively weak development of the phosphorescent spots.

Head 4¼ to 4⅓ in length; depth 5½. The mouth is oblique, the lower jaw longest, the maxillary extending beyond the eye, slightly more than half length of head. A pair of slender cutaneous slips at tip of snout. Tip of maxillary with a cutaneous flap, the free edge of which is fringed.

Mandible anteriorly with an outer series of small canines, behind which is a narrow band of short cardiform teeth. The latter pass toward sides of jaw into a single series of canines, enlarging toward angle of mouth and hooked backward and laterally. Premaxillaries with a single close-set series of slender conical teeth, a median pair slightly larger than the others, but scarcely canine-like. Vomer with a pair of widely separated canines, about equaling the large teeth in sides of mandible, and much larger than any of the palatine teeth. The latter are of small size, nearly uniform, ten to twelve in number. The eye is small, its diameter about equaling the bony interorbital width.

The lines of sense organs and phosphorescent organs of this species have been described by Dr. C. W. Greene (1899, p. 676), to whose paper we refer. As there stated, the rows agree very closely with those in *P. notatus* and *P. margaritatus*. The phosphorescent organs are, however, much smaller, proportionally, than in these species, and are less developed in the dorsal region and on top and sides of head. The following account gives the principal differences between *P. greenei* and the other species mentioned. In some minor details, it differs from the account given by Dr. Greene.

In the *dorsal* series, no phosphorescent spots are present. In the *lateral* series, there is no upper row of phosphorescent organs. In the *pleural* row, both sets of organs are constantly present; the sense organs are difficult to distinguish, as they are not accompanied by dermal filaments; the line is discontinued at a point opposite the twenty-first anal ray. Concerning the phosphorescent organs in this series in *P. notatus*, Greene says (l. c., p. 671): "The organs of this line .... have no relation to the body segments." We find that the typical arrangement, in the three species known to us, gives two spots to each anal ray, along that part of the line which is parallel with the anal fin. The spots are not equally spaced, but are rather obviously arranged in pairs, though one member of a pair is occasionally undeveloped. Both *caudal* rows are well developed as in other species. The *gastrogular* row is always complete, but the sense organs are again difficult to detect, owing to the absence of filaments. In the *upper opercular* series, and in a row along the lower edge of the black subocular blotch, the phosphorescent organs are well developed; they are absent, however, or very sparingly developed on all other series on top and sides of head.

The dorsal and anal fins are longer than in other species, the dorsal containing 2 spines and 38 or 39 rays, the anal 35 or 36 rays. The membrane of the last dorsal spine joins base of first soft ray. The last two or three dorsal rays are shortened, and the last ray is joined for its full length with the upper ray of the caudal; there is thus a notch between the two fins. The anal is continuous with the caudal, without notch, as the last rays are not shortened.

As in other species, a gland is present in the axil of the pectorals; also a series of canals penetrating the base of the fin on the axillary side, as in *Batrachoides*, one for each interradial membrane.

The color is translucent grayish or olive, with five broad dark cross-bars on back along base of dorsal fin, and a sixth on nape (including base of spinous dorsal); there are also one on occiput, one behind orbits and one on snout, the last three less intense and more or less joined. The basal portion of the pectoral fin is more or less dusky. Fins otherwise translucent, unmarked.

Twelve specimens were obtained. The species is named for Dr. Charles Wesley Greene.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm.	76	75
Head	24	24
Snout	5	5
Interorbital space (bony)	3+	3½
Eye	4	3½
Maxillary	13	12½
Depth	18	18½
Least depth at base of caudal	3½	4
Snout to dorsal	25	23
Distance between dorsals	4½	....
Base of second dorsal	70	71
Snout to anal	37	37
Base of anal	63	61
Caudal	11	11
Pectoral	18	18
Ventral	11	12

331. **Thalassophryne reticulata** *Günther.*

Teeth on mandible, vomer and palatines similar, in single series, small, nearly uniform in size, antero-posteriorly compressed so as to resemble diminutive incisors. Sometimes single teeth are crowded out of line, but they are never in two definite series, not even, as alleged, on front of mandible. The maxillary teeth are similar, but very much smaller, in two rows or a narrow band.

The last dorsal and anal rays are inserted at a distance from base of caudal equaling more than half their length. They are joined by membrane for their entire length to the caudal peduncle and to the portion of the caudal fin which they overlap.

The type is described as having 24 rays in the dorsal and 24 in the anal fin; it is figured, however, with 25 rays in the dorsal. Nine specimens counted by us show uniformly 26 rays in the dorsal fin, 25 in the anal; a tenth specimen has 27 dorsal and 25 anal rays.

Measurements in Hundredths of Length without Caudal.

Length to base of caudal in mm.	255	218
Length of head	31	31
Greatest width of head	30	30
Length of snout	6	6
Diameter of eyeball	3	3
Interorbital width	6	7
Length of maxillary	16	16
Greatest depth of body	19	19
Depth of caudal peduncle	5½	6
Snout to first dorsal spine	28	29
Base of second dorsal (to base of last ray)	56	54
Snout to front of anal	44	46
Base of anal (to base of last ray)	52	53
Length of caudal	18	20
Length of pectoral (from middle of axil)	22½	23
Length of ventral (outer ray)	14½	14½

332. **Thalassophryne dowi** *Jordan & Gilbert.*

This species seems to be rarely taken. A single specimen was obtained by us, 150 mm. long. The only others known are the three types from Punta Arenas, Costa Rica, and two specimens dredged by the Albatross in the Bay of Panama.

The lower half of the body is whitish, unmarked; the dorsal portion is blackish, relieved by the white lateral line and by a few irregular blotches of white, which are most numerous toward the middle of the sides. The head is blackish above and on sides, very finely marbled with gray. The lower lip and the front of the lower jaw are similarly marked; the gular membrane is slightly dusky; the under side of the head otherwise white. The eyes are seen with difficulty, being colored like the surrounding area. The anal is white, except some of the posterior rays, which are margined with black. The basal half of the dorsal is white or grayish, sharply contrasting with the black marginal half. The terminal half of caudal is jet-black, the basal half white, blotched more or less with brown. The ventrals are white; the pectorals white, marbled with brown on their basal portion. Teeth in premaxillaries small, in two series, the front tooth of the outer series on each side a strong conical canine. Sides of mandible with a single series of strong canines, which increase in size backward to the eighth or ninth, then suddenly diminish. On the front of the mandible, are two series of similar teeth. The vomer contains twelve canines, increasing in size laterally. The palatine teeth are in a single series, about twelve in number on each side, large and small teeth regularly alternating in the series.

The head is contained 3¾ to 4 times in the length. It is cuboid in shape, with vertical cheeks, and very oblique mouth; in appearance resembling *Astroscopus*. Greatest depth of head three-fourths its greatest width.

The last two or three rays in the dorsal and anal fins are progressively shortened, giving a rounded contour to the end of these fins. The last rays of each are united for their whole length by membrane to the caudal. In three specimens at hand the second dorsal contains respectively 30, 31, and 32 rays; the anal 29, 29, and 30.

Two pairs of filaments project from the free margin behind the upper lip, one in front of each eye, the second pair nearer the median line. A pair of similar filaments on lower lip near symphysis. No other filaments on head or body; but pairs of inconspicuous thick fleshy lobes close in front of the isolated sensory organs on the lower jaw, and on the sides and top of the head.

The opercular spine, and the spines of the dorsal fin are wholly enveloped in the integument. They contain a central canal, which opens in a shallow groove on the anterior face of the spine, at an appreciable distance below the tip.

The genus *Dactor* Jordan & Evermann (1898, pp. 2313 and 2325), of which this species is the type, seems to have little value, and is not here recognized. The characters assigned are the many rayed dorsal and anal fins, and the union of these with the caudal. Other species of *Thalassophryne* have 19, 20, and 26 rays in the dorsal fin; 18, 19, and 25 rays in the anal. It seems unwarrantable to distinguish from these generically a species containing 30 to 33 rays in the dorsal and 29 or 30 in the anal. As regards union of the dorsal and anal fins with the caudal, this occurs in varying degrees, and is not correlated with increased number of fin rays. *T. maculosa* (D. II, 19; A. 18) seems to have the fins wholly distinct; *T. amazonica* (D. II, 20; A. 18) has them completely joined; *T. reticulata* (D. II, 26; A. 25) has them almost wholly united.

Measurements in Hundredths of Length without Caudal.

Length to base of caudal in mm.	134
Length of head	27½
Greatest width of head	23½
Length of snout	4½
Diameter of eyeball	2
Interorbital width	6
Length of maxillary	13
Greatest depth of body	20
Depth of caudal peduncle	5½
Snout to first dorsal spine	25
Base of second dorsal (to base of last ray)	61
Snout to front of anal	39
Base of anal (to base of last ray)	58
Length of caudal	16
Length of pectoral (from middle of axil)	18
Length of outer ventral ray	9

Family GOBIESOCIDÆ.

333. **Gobiesox rhodospilus** *Günther.*

The types of this species are from Panama, but it was not seen by us. It is recorded by Boulenger (1898–9, Vol. XIV, p. 8) also from the Bay of Santa Helena, near Guayaquil.

Gobiesox gyrinus Jordan & Evermann (1898, p. 2331) is founded on Günther's description of specimens in the British Museum, to which he has applied the name *Gobiesox nudus* Bloch (see Günther, 1861*b*, p. 502). These specimens were partly from the West Indies, partly from the Island of Cardon (misspelled Cordova, *fide* Günther, 1868, p. 381) on the Pacific coast of Nicaragua, and are probably not conspecific. Günther's description (copied by Jordan and Evermann) was doubtless based upon the adult specimens from the West Indies, not upon the very immature Nicaraguan specimens.

Family BLENNIIDÆ.

334. **Malacoctenus delalandi** (*Cuvier & Valenciennes*).

Not seen by us; known from Mazatlan to Guayaquil (Boulenger, 1898–9, Vol. XIV, p. 8). It is recorded by Günther (1861 *a*, p. 371) from the "Pacific coast of Central America," where it was collected by Captain Dow.

335. **Mnierpes macrocephalus** (*Günther*).

This species has been taken several times at Panama, but was not seen by us. It is recorded by Boulenger (1899, p. 4) from Flamenco Island, Panama Bay.

336. **Auchenopterus monophthalmus** *Günther.*

A very abundant species in the tide-pools at Panama.

The sexes are readily distinguished by the coloration, and by the size of the mouth. In females, the lips, mandibles, and the lower portions of the cheeks and opercles are marbled or finely blotched with dark; the ventrals, the lower pectoral rays and the caudal are cross-barred. In males, all of these regions are plain, except the caudal, which may be faintly barred. In females, the mouth is small, the distance from tip of snout to tip of maxillary not exceeding (in adults) that from tip of snout to posterior edge of pupil. In males, the length of maxillary as measured above, exceeds the distance from tip of snout to posterior edge of orbit.

The first three dorsal rays form a detached fin, its posterior membrane joining fourth spine at or immediately above the base. The three spines are flexible, not pungent at tip, much weaker than the succeeding spines. The fourth spine becomes abruptly stiff and strong. So slender are the tips of the first and second spines that it is difficult to detect them where they terminate in the membrane. The first and second spines are about equal, and are somewhat longer than any of the spines in the posterior portion of the fin. The third spine is shortened, but still is longer than the fourth. The dorsal formula is III, XXVI+1. In ten specimens examined, the anal fin contained constantly 2 spines and 20 rays, the last two rays being distinct, but closely approximated at the base.

The lateral line traverses 38 to 40 scales, including the scale which overlies the base of the caudal fin and is sometimes without tube. The arched portion of the lateral line contains 18 to 20 scales, the straight portion 19 to 21. The scales constituting the upper portion of the arch are slightly enlarged, and are perforated on the anterior two-fifths only by a tube which opens on the under surface of the scale. At the summit of the arch, a single series of scales intervenes between the lateral line and the base of the dorsal fin. At the beginning of the straight portion of the lateral line, it is separated by five horizontal rows from the base of the dorsal, and by five rows from the base of the anal.

The second dorsal fin is marked by seven dark bars, which are continued more or less definitely upon the back and sides, where every alternate band is more distinct, the fainter ones being often with difficulty distinguished. On the middle of sides, the bands are variously confluent and irregular. The dorsal ocellus occupies the next to the last dorsal bar; and is rarely accompanied by a second smaller ocellus developed in the last dorsal bar (in two out of eighty specimens). No small ocellated spots are present on the dorsal fin in advance of the main ocellus. The anterior dorsal fin is without ocellus, and is variously blotched with dusky; the first spine is light, with four narrow cross-bars in the female, plain in the male. The dorsal ocellus is found between the twentieth and twenty-second spines of the second dorsal, occasionally encroaching on the membrane between nineteenth and twentieth spines. The anal shows six or seven oblique dark bars, or is more frequently uniform blackish, with a white margin. The caudal, pectorals and ventrals are finely cross-barred in females, plain in males. In females, the lips, mandibles, and lower portion of cheeks and opercles are barred or freckled, these regions plain in the males. The opercle has a dark blotch; a dark shade is usually present below the eye. A dark blotch occupies the basal portion of some of the pectoral rays, this more specialized on the lower rays in females.

Measurements in Hundredths of Length without Caudal.

	♂	♂	♀	♀
Length in mm.	67	52	67	50
Length of head	30	31	31	29
Length of snout	8	8	8	7
Length of maxillary	16	16	13½	12½
Diameter of orbit	6	6	6	6
Interorbital width	4	4	3½	3
Greatest depth	24	23	25	24
Depth of caudal peduncle	9	8	8	8½
Length of first dorsal spine	9½	10	12½	11
Length of second dorsal spine	11	11½	13	11
Length of third dorsal spine	7	7	9	7½
Length of fourth dorsal spine	6	6½	7	7
Length of twenty-sixth dorsal spine	9½	9	11	10
Length of first anal spine	6½	6½	7½	7
Length of second anal spine	8	8	9½	8½
Length of longest anal ray	12	15	15½	13½
Length of caudal fin	23	23	24	22
Length of ventral fin	19	21	22	20
Length of pectoral fin	24	24	24	24

337. **Hypsoblennius piersoni** sp. nov.

PLATE XXXII, FIG. 60.

Resembling *H. gentilis* and *H. gilberti*, but with shorter spinous dorsal and much longer soft dorsal and anal.

Head 4; depth 5. D. IX, 25; A. II, 24; P. 16; V. I, 3.*

The form is elongate, with very bluntly rounded snout, the mouth subinferior, as in the other species mentioned. There is a slender nasal tentacle, longer than in its nearest relatives. The orbital tentacle is as long as diameter of eye; above a short basal stalk, it is finely dissected to form five or six slender filaments, one or more of which may be branched. The mouth is very small, largely transverse, reaching posteriorly to a vertical midway between front and middle of pupil. No posterior canines. Gill-opening extending below to opposite lower edge of pectoral base; from this point, the margin of the branchiostegal membrane can be traced across the throat, but it is nowhere free.

---

* In six specimens of *H. gilberti* from San Diego, the fin-formula stands:

Dorsal	XII, 17	XII, 18	XII, 18	XI, 19	XII, 19	XII, 19
Anal	II, 18	II, 19	II, 19	II, 19	II, 19	II, 20

In one specimen of *H. gentilis* from San Diego, we find D. XII, 16; A. II, 18

The lateral line is conspicuously developed in its anterior part only, for a distance equaling the length of the head.

The dorsal spines are very slender, and increase regularly in length posteriorly, there being no notch between spinous and soft dorsals. It differs in this respect from related species, there being a distinct though not conspicuous notch in *H. gentilis* and *H. gilberti*.

The color is very light olivaceous, with black blotches and markings following the same pattern seen in *H. gilberti*. Along the back is a series of six quadrate blotches, below each of which is a similar smaller blotch, those anteriorly separated by a light streak corresponding in position to the lateral line. Below the middle of sides is a series of dark spots arranged in seven pairs, those of the anterior pairs developed as short vertical streaks. A few scattered smaller spots on head and sides of body. There is a narrow V-shaped bar on occiput, a broad bar downward from eye to angle of mouth, and a faint V-shaped mark on gular region. A conspicuous oval black blotch on front of spinous dorsal. The fin is translucent with dusky markings not in definite pattern. A conspicuous black point at the base of each anal ray. The anal is translucent, with a dusky lengthwise streak along the base of the distal third of the fin. Pectorals and ventrals translucent, with some dusky markings.

Named for Mr. C. J. Pierson, a member of the Panama Expedition, to whose untiring industry much of its success was due.

Measurements in Hundredths of Length without Caudal.

Length in mm. to base of caudal.........	32
Head..	25
Snout	7
Eye..	7+
Gape of mouth	7
Interorbital width	2½
Length of orbital filament..................	8
Depth of body..................................	20
Depth of caudal peduncle..................	8
Length of dorsal base	80
Length of anal base..........................	53
Length of pectorals..........................	22
Length of ventrals............................	15
Length of caudal	15

338. **Hypsoblennius striatus** (*Steindachner*).

Abundant in the tide-pools of the Panama reef.

The following details may be added to the original account given by Steindachner (1877, p. 15, Pl. VIII, fig. 4):

The free tips of the rays and spines of the dorsal fin are white, the color less intense than that on anal margin. The edge of the membrane between the spines and between the anterior dorsal rays is black, contrasting sharply with the white-tipped spines and rays. A well-defined elliptical spot of jet-black occupies the membrane between the first and second dorsal spines; it is nearly as large as the eye, and is margined with a whitish ring. The blackish blotch, mentioned by Steindachner, between third and fifth dorsal spines is diffuse and ill-defined, and sometimes extends beyond the limits assigned. There is a black spot at the base of each anal ray. The ventrals have the basal portion dusky, the distal third or half of each ray white. The supraorbital tentacle is crossed with red and whitish bars.

The usual fin-formula is dorsal XII, 16; anal 20: occasionally dorsal XII, 15; anal 19. The dorsal spines are constantly twelve, and the dorsal rays never as numerous as seventeen. Steindachner's type, described with seventeen dorsal rays, is figured with sixteen rays. The pectoral fin contains constantly fourteen rays, as figured, not fifteen, as stated in the description. The ventrals are described with one spine and two rays. They have constantly one spine and three rays. The spine is short but strong, and the inner ray is usually hidden in the integument enveloping the second ray, but is sometimes distinguishable externally. The ventral fins have been examined by us in *H. gilberti*, *scrutator*, *punctatus* and *gentilis*, and are found to contain constantly one spine and three rays.

The interorbital space is rather deeply grooved. The anterior nostril is in a short tube, the posterior rim provided with a cirrus. The long supraorbital tentacles are unfortunately omitted in Steindachner's drawing. The length of the gill-slit equals the distance from the tip of the snout to the front of the pupil, scarcely extending below to the level of lower base of pectorals.

A short lateral line extends to or into the second dark cross-band behind the head, its posterior portion more or less broken up into detached fragments. It gives off a few short and irregular branches above and below, each ending in an open pore.

We have examined the mandibular teeth in twenty specimens without finding a posterior canine, such as was reported by Steindachner in one of his typical examples.

339. **Hypsoblennius brevipinnis** (*Günther*).

The species is apparently rare, as but one young specimen was obtained.

Homesthes *Gilbert.*

Homesthes GILBERT (JORDAN & EVERMANN, 1898, p. 2394) (*caulopus*).

Differing from *Hypsoblennius* chiefly in the presence of four articulated ventral rays instead of three as is usual in *Blenniinæ*. We have examined the ventrals of *Hypsoblennius striatus*, *punctatus*, *ionthas*, *gentilis*, and *gilberti*, and have found them to consist constantly of one short strong spine and three simple articulated rays. In *Homesthes caulopus* there is one strong short spine and four well-developed simple jointed rays.

340. Homesthes caulopus *Gilbert.*

PLATE XXXII, FIG. 61.

Homesthes caulopus GILBERT, *l. c.*, p. 2394.

Head 3⅔ in length; depth at base of ventrals 4, at middle of abdomen 3⅜; least depth of caudal peduncle 3 in length of head; snout 4; eye 4 to 4⅓; longest dorsal spine 2⅔; last dorsal spine 3⅓; longest (tenth) dorsal ray 2; longest (fifteenth) anal ray 2⅓; ventrals 1⅝; longest pectoral ray 1⅜ to 1⅔; caudal 1⅓. Dorsal XII, 15 or 16; anal II, 17; pectorals 14; ventrals I, 4.

Robust, moderately compressed, with wide heavy head and short bluntly rounded snout, the anterior profile of which is nearly vertical. In shape and general appearance much resembling *Hypsoblennius gilberti.* Mouth very wide, horizontal, short, the maxillaries reaching vertical from hinder edge of pupil, 3 to 3⅓ in head. Teeth as usual in this group, the posterior not enlarged or canine-like. Nostrils with slightly elevated margins, scarcely tubular, the hinder edge of anterior nostril produced into a conspicuous laciniate flap, about two-thirds as long as the diameter of orbit. A similar but larger orbital cirrus, divided nearly to the base into six or eight slender filaments. Interorbital space deeply grooved, without median ridge, opening posteriorly into the deep transverse groove which separates the orbital region from the somewhat swollen occiput, its width 1⅓ eye. The mucous canals of head give off transverse branches which open by numerous pores, which thickly beset the snout, subocular region, top of head, preopercle, and upper portion of opercle. Width of gill-slit equaling or slightly exceeding one-half length of head, confined to area above lower base of pectorals.

First dorsal spine over margin of preopercle; spinous dorsal low, of nearly uniform height, much lower than second dorsal, the spines rather strong at base, with weak reflexed tips; membrane of last dorsal ray joined to extreme base of rudimentary caudal rays. Anal low, rising slightly posteriorly, leaving a short free interval between its last ray and the caudal.

Lateral line strongly developed anteriorly for a distance equaling length of head; from that point it is only faintly visible, declining abruptly to middle of sides, along which it may be traced to base of caudal; the anterior portion gives off numerous pairs of short transverse lines, each of which ends in a pore; no pores or lines are visible posteriorly.

Blackish, without sharp markings, the sides with irregular light blotches, some of which are subcircular in outline and contain one or more black central specks; the light markings near the back are elongate and vertically placed, faintly outlining dark bars of the ground color; lower parts lighter. A vertical black blotch on cheek behind eye; no distinct bars on head; tentacles whitish. Fins all blackish; the anal, the ventrals, the lower caudal and pectoral rays deeper black; anal and caudal margined with white, some of the dorsal rays narrowly tipped with white.

Two specimens, 102 and 115 mm. long, from Panama Bay.

341. Scartichthys rubropunctatus (*Cuvier & Valenciennes*).

Recorded once from Panama (Jordan & Gilbert, 1882 *n*, p. 628).

342. Rupiscartes atlanticus (*Cuvier & Valenciennes*).

There is no Panama record for this species, which is known, however, from the Mexican coast to Guayaquil (Boulenger, 1898–9, Vol. XIV, p. 8).

343. Emblemaria nivipes *Jordan & Gilbert.*

The type from Pearl Islands, Panama Bay; not seen by us.

Family CERDALIDÆ.

344. Microdesmus dipus *Günther*.

Not seen by us. In addition to the type, this species is known only from a specimen recorded by Lockington (1881, p. 114), from La Paz, L. C.

Dr. G. A. Boulenger has kindly re-examined for us the type of the species, and writes: "There are four ventral rays. The fifteen anterior dorsal rays are simple and inarticulate; further back they gradually become branched and articulate, and are distinctly so from the eighteenth. The anal rays are all articulate and branched."

345. Microdesmus retropinnis *Jordan & Gilbert*.

Plate XXXI, Fig. 59.

Seven specimens were obtained in rock-pools on the Panama reef.

The genus *Microdesmus*—with the two species *M. dipus* and *M. retropinnis*—has been described as having the ventrals reduced each to a single ray. Our material has shown, however, that in *M. retropinnis* a serious error was committed, for each ventral fin consists of a short slender spine and three slender unbranched rays, the inner of which is the longest. Through the great kindness of Dr. G. A. Boulenger, who has examined for us the type of *M. dipus*, we learn that that species also has "four ventral rays" (undoubtedly one spine and three rays).

In *M. retropinnis*, the dorsal fin contains 15 slender spines and 32 to 34 rays. Each of the rays is definitely articulated, and the majority of them are many times forked. The anal rays are all articulate and all but the first one forked.

We are informed by Dr. Boulenger that in *M. dipus* also the fifteen anterior dorsal rays are simple and inarticulate, while further back they gradually become branched and articulate, being distinctly so from the eighteenth back. In this species the anal rays are all articulate and branched.

In one specimen of *M. retropinnis*, we enumerate 58 vertebræ in addition to the hypural element. The latter is assisted by one spine in forming the basis for attachment of the caudal fin.

In six specimens the fins count as follows:

Dorsal....................	49	48	48	48	47	47
Anal	29	30	30	31	29	29

The scales are circular in outline, attached by their entire margin, and are non-imbricate. On the head and the anterior part of the body, they are closely crowded and are arranged in definite rows. Toward the tail, they are more widely spaced, and on the abdomen they are partially or wholly embedded and difficult to detect. They cover the entire head, including snout and branchiostegal membranes.

The margin of the upper jaw is formed by the premaxillaries, the broad maxillary lying behind it. The teeth are strong and conic, with rather acute tips; those in the mandible are in two rows anteriorly which narrow to a single series laterally; those in upper jaw apparently in a single series.

346. Cerdale ionthas *Jordan & Gilbert.*

PLATE XXXI, FIG. 58.

Eighteen specimens were secured on the Panama reef. The genus *Cerdale* was described as differing from *Microdesmus* in having two rays in the ventral fin, but this was due to an error in observation. As in *Microdesmus*, the ventral fin contains one spine and three rays. The two genera seem to differ only in the much shorter body and fewer vertebræ in *Cerdale*. The vertebræ are 20+23 in number in addition to the hypural element. One hæmal spine assists the hypural in supporting the caudal fin.

The dorsal fin contains 12 slender spines and 30 to 32 branched articulate rays. The anal contains 27 to 29 branched rays (by error given 36 to 38 rays, instead of 26 to 28, in the original description and subsequently).

Following are the fin-counts in twelve specimens:

Dorsal	44	44	44	44	44	44	43	43	43	43	43	42
Anal	28	28	28	28	28	27	28	28	28	27	27	29

The pectoral fin contains fourteen rays.

The post-temporal is forked, and rather firmly joined to the skull. The supraclavicle is apparently absent. The actinosts are thin, flat, and very large, the three uppermost joining the hypercoracoid, the lower one joining the hypocoracoid. The opercular bones are all present.

The front of the mouth is formed by the premaxillaries only. The maxillaries are slender and much curved. The teeth are small and conic in both jaws, uniserial in the premaxillaries, biserial in front of mandible becoming uniserial laterally. No teeth on vomer or palatines.

The branchiostegal rays are five in number.

The restricted gill-openings can scarcely suffice to distinguish a family Cerdalidæ from the Blenniidæ.

Family OPHIDIIDÆ.

347. Lepophidium prorates (*Jordan & Bollman*).

Known only from type and co-types taken in Panama Bay.

348. Otophidium indefatigabile *Jordan & Bollmann.*

Recorded from Albatross Station 2797, Panama Bay, 33 fathoms (Gilbert, 1890 *b*, p. 453).

Family FIERASFERIDÆ.

349. **Fierasfer dubius** *Putnam.*

A single specimen, 58 mm. long, was taken in a tide-pool at Panama. We think it better to use the name *dubius* rather than *affinis* (Günther) for this species. The type locality for *dubius* is the Pearl Islands, near Panama; while the locality of *affinis* is unknown, and the description inadequate. In our very small specimen, the head is one-eighth the length, the dorsal begins a head's length behind the occiput, the pectoral equals the maxillary and is half as long as the head. The outer mandibular teeth, and the teeth on front of vomer are slightly enlarged.

Family BROTULIDÆ.

350. **Ogilbia ventralis** (*Gill*).

Not rare in tide-pools on the Panama reef. Heretofore known only from Mazatlan and Cape San Lucas.

The tip of the snout and the terminal portion of mandible are furnished with sharply elevated curving sensory ridges.

Family BREGMACEROTIDÆ.

351. **Bregmaceros macclellandi** *Thompson.*

Dredged by the Albatross in Panama Bay, Station 2804, 47 fathoms; these are the types of *B. bathymaster*, Jordan and Bollman, 1889, p. 173 (see Jordan and Evermann, 1898 *b*, p. 2526).

Family PLEURONECTIDÆ.

352. **Hippoglossina bollmani** *Gilbert.*

The types only known, from Albatross Stations 2804 and 2805, Panama Bay, 47 and 51½ fathoms.

353. **Paralichthys woolmanni** *Jordan & Williams.*

The type of this species was collected by the Albatross, in 1888, at Panama, and was first listed by Jordan and Bollman (1889, p. 182) as *P. adspersus* Steindachner. Later, when made the type of a new species, it was erroneously credited to the Galapagos Islands. The species is abundant at Panama, where we obtained numerous specimens, and is known to range as far north as the Gulf of California (Mazatlan, Guaymas, La Paz). Specimens from Mazatlan and La Paz have been distinguished under the name *P. sinaloæ* Jordan and Abbott (see Jordan & Evermann, 1898, p. 2872), but seem to differ in no respect from *P. woolmanni*.

In ten specimens from Panama, the fin-rays and gill-rakers are as follows:

Dorsal	70	70	70	72	73	73	74	75	75	76
Anal	52	53	54	58	56	57	57	58	58	58
Gill-rakers	12	14	14	13	14	13	14	14	13	13

In nine specimens from Mazatlan (including the type of *P. sinaloa*), the gill-rakers on horizontal limb of arch are constantly thirteen or fourteen in number, and the fin rays as follows:

Dorsal	72	72	73	73	73	73	74	76	76
Anal	56	57	56	58	58	59	56	60	61

The longest gill-raker in *P. woolmanni* is two-fifths to one-third as long as the diameter of the eye; on the vertical limb of the arch 4 or 5 are usually present, 1 or 2 of which may be immovable and rudimentary.

In the northern portion of its range, *P. woolmanni* is accompanied by the closely related *P. æstuarius*, which differs in its more elongate form, the longer, more numerous gill-rakers, the more numerous fin-rays, and the lighter, more nearly uniform coloration; a row of distinct small white spots follows the contour of the body, near the base of the vertical fins. *P. magdalenæ* Abbott (Jordan & Evermann, 1898, p. 2871), is a synonym of *P. æstuarius*. We have compared the types of the two species.

Measurements in Hundredths of Length without Caudal.

Locality	Panama		Guaymas, Mex.
Total length in mm	272	270	260
Length to base of caudal in mm	219	219	208
Head (without opercular membrane)	28½	29½	30½
Snout (to upper eye)	6½	6+	7
Maxillary	14	14+	15
Upper eye	5	5+	5½
Interorbital width (total)	2⅓	2½	2⅓
Greatest depth	45	46½	47½
Depth of caudal peduncle	12	12+	12½
Longest gill-raker	2½	2¾	2½
Length of caudal	24	23½	24
Length of ventral	8½	9	8½
Length of pectoral	14	14½	14
Longest dorsal ray	13	13	12½
Longest anal ray	13	13	12
Chord of arch of lateral line	....	15½	15

354. **Ancylopsetta dendritica** *Gilbert.*

PLATE XXXIII, FIG. 62.

Hippoglossina sabanensis BOULENGER, 1899, p. 4.

Infrequent; five specimens obtained.

In this species the tubes of the lateral line are profusely branched in adults, but the structure does not differ from that found in other flounders with branched tubes. We are unable, therefore, to recognize the genus *Ramularia* Jordan and Evermann (1898, p. 2633) based on this character. The species is closely related to *A. quadrocellata* Gill, from which it differs most strikingly in having the anterior dorsal rays not produced. This also we consider of less than generic importance.

Our specimens are smaller than the type. The depth is $1\frac{5}{6}$ in the length. The interorbital width is about half the diameter of the upper eye. The length of the maxillary is contained $2\frac{2}{3}$ to $2\frac{3}{4}$ times in the length of the head. The color is blackish brown, becoming black on distal portion of vertical fins, which are narrowly margined with white. The fins are similarly colored on the blind side; the head and body of the blind side are also more or less washed with dark brown, especially around the margins. The ocellated spots are arranged as in *A. quadrocellata*, but the one above the arch of the lateral line is wanting. The central light spot is yellow in life.

In five specimens, the fin-rays are as follows:

Dorsal	77	79	79	82	84
Anal	64	64	65	67	67

This is the species described by Boulenger (1899, p. 4) from Rio Sabana, under the name *Hippoglossina sabanensis*.

355. **Platophrys constellatus** *Jordan.*

Taken by the Albatross in Panama Bay, at Stations 2795, 2796, 2797, at a depth of 33 fathoms (Jordan & Bollman, 1889, p. 183).

356. **Engyophrys sancti-laurentii** *Jordan & Bollmann.*

Panama Bay, Stations 2795 and 2805, depths 33 and $51\frac{1}{2}$ fathoms; recorded by Garman (1899, p. 222).

357. **Syacium latifrons** (*Jordan & Gilbert*).

Known only from the types, which were taken at Panama.

358. **Syacium ovale** (*Günther*).

But few seen; nine specimens obtained. None of these show any tendency to increased width of interorbital space.

359. Cyclopsetta querna (*Jordan & Bollman*).

Abundant. In adult specimens, 255 mm. long, the colored side is uniform dusky brown on head, body and fins, the fins without dusky blotches.

The tubes of the lateral line are profusely branched above and below. An intricate network of branching tubes covers the preopercle and the postocular region of the head. The upper eye is distant from profile a distance less than diameter of pupil. The interorbital width in adults equals half the diameter of the eye.

360. Azevia panamensis (*Steindachner*).

Infrequent; but four specimens secured.

The scales on the colored side of the body are strongly ctenoid, those of the uncolored side perfectly smooth.

361. Citharichthys platophrys *Gilbert*.

Known from the type only; Albatross Station 2799, Panama Bay, 29½ fathoms.

362. Citharichthys gilberti *Jenkins & Evermann*.

Abundant; differing from *C. spilopterus* in the longer* gill-rakers, which are also more numerous, in the slightly larger scales, and the slightly larger eye. In our specimens, the lateral line traverses 40 to 43 scales. In nine specimens of *C. spilopterus* from Havana, there are 45 to 47 scales in the lateral line. Our specimens of *gilberti* have thirteen or fourteen gill-rakers on horizontal limb of outer arch. Havana specimens of *spilopterus* have constantly eleven gill-rakers.

363. Etropus crossotus *Jordan & Gilbert*.

But few seen by us.

Family SOLEIDÆ.

364. Achirus klunzingeri (*Steindachner*).

Common in Panama Bay.

Resembling *A. mazatlanus*, but differing in the smaller scales, the smaller eye and wider interorbital space, the larger mouth, the increased number of fin-rays, the finer, more numerous cilia (in specimens of equal size), and the more elongate form.

The color is almost uniform brown on body and fins; in lighter specimens only are the vertical fins faintly mottled or blotched with dusky. Ten to twelve faint dark hair-lines cross the body, often to be made out with extreme difficulty. Young specimens show numerous patches of fine black cilia on head and body, the larger patches arranged in two series nearly midway between the lateral line and the bases of dorsal and anal fins respectively. In older specimens, the cilia are less numerous, and usually disappear entirely in adults.

---

* By error, Jordan and Evermann (1898, p. 2686) state that the gill-rakers in this species are *shorter* than in *C. spilopterus*.

As in *A. mazatlanus*, the lower two-thirds of the opercle, as well as the subopercle and the preopercle on the blind side are naked; in *A. klunzingeri*, the scales on cheeks and upper part of opercles are non-imbricate and frequently smooth, especially in specimens of large size.

The eyes are small and distant, the interocular space usually wider than the diameter of the eye. The pectoral varies widely in length and in the number of rays, seven specimens showing respectively 5, 5, 4, 4, 4, 3 and 2 pectoral rays. In five specimens there are 71 to 76 oblique rows of scales running downward and backward to the lateral line. In five specimens of *A. mazatlanus*, there are 54 to 61 oblique rows. In three specimens of *A. klunzingeri*, there are 62 to 64 dorsal rays, 46 to 49 anal rays; in four specimens of *A. mazatlanus*, 52 to 55 dorsal rays, 40 to 43 anal rays.

Measurements in Hundredths of Length without Caudal.

Length to base of caudal in mm.	160
Head	27
Snout	8
Maxillary	10½
Eye	2⅔
Interorbital width	2½
Depth	64
Depth of caudal peduncle	20
Length of caudal fin	30
Length of pectoral	4
Longest dorsal ray	14½
Longest anal ray	15

365. Achirus fonsecensis (*Günther*).

Solea fonsecensis GÜNTHER, 1862, p. 475 (Gulf of Fonseca).
Solea fischeri STEINDACHNER, 1879 *c*, p. 13, Pl. II, fig. 8 (Rio Mamoni, near Panama).
Solea panamensis STEINDACHNER, 1877, p. 10, Pl. II (Panama).

This species is abundant in the Bay of Panama and appears frequently in the market. It has not been recorded south of this point, but extends to the northward as far as Mazatlan.

The pectoral fin is greatly reduced, containing usually two short divergent rays, which fail to equal the diameter of the orbit. In one of our specimens three rays are present, four specimens have but a single ray each, while two specimens are without any trace of a pectoral fin. *A. fischeri*, based on a young specimen with one pectoral ray, and *S. panamensis*, based on an adult specimen without pectoral, are duplicated by our material, and are to be considered as synonyms of *A. fonsecensis.* The best description and figure are given by Steindachner under the name of *S. panamensis.* The figure should be reversed.

The scales along the lateral line are 60 to 65 in number, not about 85, as stated by Günther. In ten specimens, the fin-rays run as follows:

Dorsal	61	61	61	60	60	60	59	58	57	57
Anal	45	45	42	45	45	44	44	44	43	43

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm	150	158
Head	27½	27
Snout	9	8½
Maxillary	10½	10
Eye	3	2¾
Interorbital width	3	2½
Depth	61	70
Depth of caudal peduncle	20	18½
Length of caudal fin	29	26½
Length of pectoral fin	2½	3
Longest dorsal ray	14½	13½
Longest anal ray	15	13½

366. **Achirus scutum** (*Günther*).

Known only from Panama and the Gulf of Fonseca; not recognized until now since the original description. We found the species abundant at Panama, securing about thirty specimens, the largest 18 cm. long.

The species is strikingly marked with numerous narrow gray bars on a dark brown background, the bars varying in number from thirteen to twenty, often pursuing a wavy course and forking or coalescing with adjacent bars in a most irregular and intricate way. In some specimens, the irregularities are few in number. The dorsal and anal are marked like the body, but the caudal is much lighter, crossed by about four irregular dark bars which often break up into series of roundish spots.

The pectoral is usually shorter than the eye and contains three rays, of which the middle is the longest. In twenty-five specimens, eight were found with two rays, and three with four rays. In five specimens, the fin-rays are as follows:

Dorsal	56	55	54	54	53
Anal	44	43	43	42	43

In the original description, the anal fin is said to have 48 rays, but there must have been included by inadvertence the five rays of the right ventral fin, which is continuous with the anal fin. There are 70 to 80 oblique rows of scales running downwards and backwards above the lateral line. The blind side of the head in advance of the preopercle, and the anterior rays of the dorsal and anal fins are fringed with rows and clusters of filaments. These are not so long or so numerous as in *A. fonsecensis*.

Measurements in Hundredths of Length without Caudal

Length to base of caudal in mm	139	125
Length of head	28½	28
Length of snout	9	8⅓
Length of maxillary	10	10
Diameter of eye	4	4
Interorbital width	2½	3
Greatest depth	76	75
Depth of caudal peduncle	20½	20
Length of caudal fin	31	31½
Length of pectoral fin	3	3½
Longest dorsal ray	15½	17
Longest anal ray	16	17

367. **Symphurus atramentatus** *Jordan & Bollman.*

Known from specimens dredged by the Albatross in Panama Bay at Stations 2795, 2797 and 2805, depths 33 to 51½ fathoms; recorded by Garman (1899, p. 229).

368. **Symphurus elongatus** (*Günther*).

Occasional in the Panama market, reaching a large size, the largest specimen seen by us being 255 mm. long. In adults, the depth is contained 3⅓ to 3⅔ in the length, thus much greater than has been ascribed to the species.

Measurements in Hundredths of Length without Caudal.

Length without caudal in mm.	225	233	189	170	137
Head	19	21	20	20½	20
Depth	28	27½	29	28	24½
Maxillary	5	5½	5½	5½	5
Snout to lower eye	5	5	5	4¾	3¾
Length of lower eye	1¾	2	1¾	2	1½
Length of ventral	6	5½	6	6	6
Longest dorsal ray	7	7	7	7½	7
Longest anal ray	7	7	7	7½	7½
Length of caudal fin	8	8	8	10	10½
Height of gill-opening	7	6½	6½	7	6½
Scales	96	99	93	95	95
Dorsal rays	106	110	108	107	104
Anal rays	88	92	87	87	89

369. **Symphurus atricaudus** (*Jordan & Gilbert*).

A specimen of this species has been listed from Panama by Eigenmann (1894, p. 632). The record is in need of verification.

370. **Symphurus leei** *Jordan & Bollman.*

Recorded from Albatross Stations 2800, 2802, 2803 and 2804, depths 7 to 51½ fathoms.

371. **Lophiomus caulinaris** *Garman.*

Described by Garman (1899, p. 79) from Albatross Stations 3387 and 3391, off Panama, in depths of 127 and 153 fathoms. It had been previously recorded by Gilbert (1890 *b*, p. 454) as *L. setigerus*, from Station 2805, Panama Bay, 51½ fathoms.

372. **Antennarius strigatus** *Gill.*

Not seen by us.

373. **Antennarius sanguineus** *Gill.*

Not seen by us.

374. **Zalieutes elater** (*Jordan & Gilbert*).

Recorded from Stations 2794 and 2795, depths 62 and 33 fathoms (Gilbert, 1890 *b*, p. 455); and from Panama (Jordan & Bollman, 1889, p. 183).

GENERAL REMARKS ON DISTRIBUTION.

The ichthyological province to which Panama belongs extends to the northward as far as the Gulf of California and Magdalena Bay. Of the 374 species recorded from Panama, 204 are now known to occur in the Gulf of California, and further exploration will certainly increase this list. The two regions differ principally in the greater development at Panama of Siluroids and Sciænoids, the majority of which fail to reach the northern limits of the province.

To the south of Panama, the faunal relations are as yet poorly defined. The coast of Ecuador is known to us principally from Boulenger's (1898–9) brief account of a collection from the Bay of Santa Helena, near Guayaquil. The marine species there listed belong almost exclusively to the Panama fauna, and include many characteristic forms. How much farther to the southward these extend their range is unknown. The coast of Peru is largely unexplored, but the very incomplete lists which we possess indicate an almost total absence of Panama species. When these coasts shall be adequately investigated, there will probably be discovered a rather sharp line of demarcation of faunas, corresponding with the interval between the areas of the South Equatorial and the Equatorial Counter Currents.

Much has been written concerning the close parallelism between the fish-faunas on opposite sides of the Isthmus of Panama, and the bearing of this upon the question of a water-way formerly open between the two oceans. A full bibliography of the subject is given by Gregory (1895), together with a résumé of the geological and biological evidence for the former existence of such an interoceanic connection, and a discussion of the probable date of its occurrence.

From the biological side, the subject is treated in a most satisfactory way by Faxon (1895), with whose views we find ourselves wholly in accord. The ichthyological evidence is overwhelmingly in favor of the existence of a former open communication between the two oceans, which must have become closed at a period sufficiently remote from the present to have permitted the specific differentiation of a very large majority of the forms involved. That this differentiation progressed at widely varying rates in different instances becomes at once apparent. A small minority of the species remain wholly unchanged, so far as we have been able to determine that point. A larger number have become distinguished from their representatives of the opposite coast by minute (but not "trivial") differences, which are wholly constant. From such "representative forms," we pass by imperceptible gradation to species much more widely separated, whose immediate relation in the past we cannot confidently affirm. Of identical species, occurring in both

January 25, 1904.

oceans, our Panama list contains 43, as shown on the appended table of distribution. To these should be added the following forms, unrecorded as yet from Panama, but known from other localities on the Pacific Coast of North America:

- Manta birostris
- Trachurus picturatus
- Trachurus trachurus
- Caranx lugubris
- Thunnus thynnus
- Germo alalunga
- Scomber colias
- Remora albescens
- Mola mola
- Diodon hystrix
- Lampris luna

The total number of identical species which we recognize in the two faunas now separated by the Isthmus is therefore 54, as compared with the 71 enumerated by Jordan (1885). It is obvious, however, that the striking resemblances between the two faunas are shown as well by slightly divergent as by identical species, and the evidence in favor of interoceanic connection is not weakened by an increase in one list at the expense of the other. All evidence concurs in fixing the date of that connection at some time prior to the Pleistocene, probably in the early Miocene. When geological data shall be adequate definitely to determine that date, it will give us the best known measure of the rate of evolution in fishes.

Of the 82 families of fishes represented at Panama, all but 3 (Cerdalidæ, Cirrhitidæ and Nematistiidæ) occur also on the Atlantic side of Central America; while of the 218 genera of our Panama list, no fewer than 170 are common to both oceans. The well-developed families Centropomidæ and Dactyloscopidæ are peculiar to the two tropical faunas now separated by the Isthmus of Panama.

Table of Distribution.

The following table indicates the distribution of Panama fishes, in so far as they have been reported from the Gulf of California, the Galapagos Islands, the coasts of Ecuador and Peru, and the Atlantic Ocean. For the Gulf of California, we have depended upon Jordan (1895 *b*), Evermann and Jenkins (1891), and Gill (1862). For the Galapagos Islands, we have at hand a manuscript list by Messrs. Snodgrass and Heller. Ecuador is known to us principally through the list published by Boulenger (1898–9), and Peru through the paper by Abbott (1899 *a*). Very few characteristically South American forms extend their range northward to Panama; and very few species from the Indo-Pacific fauna reach the continental shore-line, though a somewhat larger number of the latter find their way to the series of outlying islands (Revillagigedos and Galapagos).

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Ginglymostoma cirratum	+		+		+
Mustelus lunulatus	+				
Galeus dorsalis	+			+	
Galeocerdo tigrinus	+				+
Carcharias æthalorus	+				
Carcharias velox					
Carcharias cerdale					
Carcharias azureus					
Scoliodon longurio	+				
Sphyrna tiburo	+				+
Sphyrna tudes	+	+			+
Sphyrna zygæna	+				+
Squalus sucklii					
Pristis zephyreus	+				
Rhinobatus leucorhynchus					
Zapteryx xyster					
Raja equatorialis					
Narcine entemedor	+				
Discopyge ommata	+				
Urolophus halleri	+				
Urolophus mundus	+				
Urolophus goodei			+		
Urolophus aspidurus					
Dasyatis longa	+	+			
Pteroplatea crebripunctata	+				
Aetobatus narinari	+				+
Myliobatis asperrimus					
Felichthys panamensis	+				
Felichthys pinnimaculatus	+		+		
Galeichthys lentiginosus					
Galeichthys peruvianus				+	

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Galeichthys eigenmanni					
Galeichthys jordani					
Galeichthys xenauchen					
Galeichthys guatemalensis	+				
Galeichthys dasycephalus					
Galeichthys longicephalus					
Sciadeichthys troscheli	+				
Selenaspis dowi			+		
Netuma kessleri			+		
Netuma insculpta					
Netuma planiceps					
Netuma platypogon				+	
Netuma oscula					
Netuma elattura					
Tachysurus steindachneri					
Tachysurus emmelane					
Tachysurus furthii					
Tachysurus evermanni					
Tachysurus multiradiatus					
Cathorops hypophthalmus					
Cathorops gulosus					
Symbranchus marmoratus					+
Congrellus gilberti					
Congrellus nitens					
Congrellus proriger					
Murænesox coniceps	+				
Neoconger vermiformis	+				
Myrophis vafer	+				
Myrichthys tigrinus	+				
Pisoodonophis daspilotus					
Ophichthus triserialis	+	+			

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Ophichthus zophochir	+				
Rabula panamensis					
Lycodontis verrilli					
Lycodontis dovii	+	+			
Muræna clepsydra			+		
Muræna lentiginosa	+	+			
Elops saurus	+		+		+
Albula vulpes	+				+
Sardinella stolifera	+		+		
Opisthonema libertate	+	+			
Ilisha furthi					
Opisthopterus dovii					
Opisthopterus macrops					
Odontognathus panamensis					
Anchovia miarcha	+				
Anchovia ischana	+				
Anchovia curta	+				
Anchovia opercularis	+				
Anchovia lucida	+				
Anchovia rastralis					
Anchovia naso					
Anchovia starksi					
Anchovia panamensis					
Anchovia mundeola					
Anchovia spinifera					+
Anchovia macrolepidota	+				
Cetengraulis mysticetus					
Cetengraulis engymen					
Lycengraulis poeyi					
Synodus evermanni	+				
Synodus scituliceps	+				

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Pœcilia elongata					
Pœcilia boucardii					
Anableps dowei					
Tylosurus scapularis					
Tylosurus stolzmanni	+			+	
Tylosurus fodiator	+				
Tylosurus pacificus					
Hyporhamphus unifasciatus	+		+		+
Hyporhamphus roberti	+	+			+
Hemirhamphus saltator			+		
Fodiator acutus	+*		+		+
Cypselurus callopterus					
Exonautes rufipinnis				+	+
Fistularia depressa	+				
Fistularia corneta	+				
Siphostoma auliscus	+				
Hippocampus ingens	+		+		
Kirtlandia pachylepis					
Kirtlandia gilberti					
Atherinella panamensis					
Mugil cephalus	+	+		+	+
Mugil thoburni		+			
Mugil curema	+	+	+		+
Mugil hospes	+				
Chænomugil proboscideus	+	+			
Querimana harengus	+	+		+	
Sphyræna ensis	+				
Polydactylus approximans	+		+	+	
Polydactylus opercularis	+				
Myripristis occidentalis	+	+			
Myripristis pœcilopus	+				

---

* San Luis Gonzales Bay (Albatross).

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Holocentrus suborbitalis	+	+			
Upeneus grandisquamis	+		+		
Sarda chilensis	+			+	
Scomberomorus sierra	+	+			
Trichiurus lepturus	+		+		+
Nematistius pectoralis	+				
Oligoplites saurus	+		+		+
Oligoplites altus			+		
Oligoplites refulgens					
Oligoplites mundus	+				
Trachurops crumenophthalmus	+	+			+
Hemicaranx atrimanus					
Hemicaranx zelotes					
Hemicaranx furthii					
Hemicaranx leucurus					
Caranx vinctus	+				
Caranx hippos	+		+		+
Caranx caballus	+	+			
Caranx marginatus	+	+	+		
Gnathanodon speciosus	+				
Citula dorsalis	+				
Alectis ciliaris	+				+
Vomer setipinnis	+		+		+
Selene œrstedii	+				
Selene vomer	+				+
Chloroscombrus orqueta	+				
Trachinotus rhodopus	+				
Trachinotus culveri	+				
Trachinotus kennedyi	+				
Trachinotus paloma	+				
Nomeus gronovii		+			+

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Peprilus palometa					
Peprilus snyderi					
Peprilus medius	+				
Apogon dovii	+				
Centropomus undecimalis			+		+
Centropomus nigrescens					
Centropomus pedimacula					+
Centropomus unionensis					
Centropomus armatus					
Centropomus robalito	+				
Petrometopon panamensis					
Epinephelus analogus	+	+			
Epinephelus labriformis	+	+	+		
Promicrops guttatus	+				+
Alphestes multiguttatus	+		+		
Mycteroperca boulengeri	+				
Hypoplectrus lamprurus					
Paralabrax humeralis				+	
Diplectrum radiale	+				+
Diplectrum macropoma	+				
Diplectrum euryplectrum					
Prionodes fasciatus	+	+			
Paranthias furcifer	+	+			+
Rhegma thaumasium					
Rypticus nigripinnis	+				
Lobotes pacificus	+				
Pseudopriacanthus serrula					
Hoplopagrus guentheri	+				
Lutianus jordani		+			
Lutianus novemfasciatus	+				
Lutianus argentiventris	+	+			

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Lutianus colorado	+				
Lutianus guttatus	+				
Lutianus aratus	+				
Rabirubia inermis	+				
Xenichthys xanti	+				
Hæmulon scudderi	+		+		
Hæmulon steindachneri	+				+
Lythrulon flaviguttatum	+				
Orthostœchus maculicauda	+				
Anisotremus pacifici			+		
Anisotremus cæsius	+				
Anisotremus dovii	+				
Anisotremus interruptus	+		+		
Anisotremus tæniatus	+		+		
Brachydeuterus nitidus	+				
Brachydeuterus leuciscus	+		+		
Pomadasis panamensis	+				
Pomadasis bayanus	+				
Pomadasis macracanthus	+		+		
Pomadasis branicki	+				
Orthopristis chalceus	+	+			
Orthopristis brevipinnis	+				
Calamus brachysomus	+		+		
Eucinostomus californiensis	+				
Xystæma cinereum	+	+			+
Gerres aureolus					
Gerres peruvianus	+			+	
Gerres brevimanus					
Kyphosus elegans	+	+			
Sectator ocyurus					
Isopisthus remifer					

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Cynoscion prædatorius					
Cynoscion squamipinnis					
Cynoscion othonopterus	+				
Cynoscion reticulatus	+				
Cynoscion albus					
Cynoscion stolzmanni				+	
Cynoscion phoxocephalus					
Sagenichthys mordax					
Nebris occidentalis					
Larimus argenteus	+				
Larimus effulgens					
Larimus acclivis	+				
Larimus pacificus					
Odontoscion xanthops					
Corvula macrops	+				
Elattarchus archidium			+		
Bairdiella ensifera			+		
Bairdiella armata					+
Bairdiella chrysoleuca			+		
Stellifer oscitans					
Stellifer furthi					
Stellifer illecebrosus					
Stellifer ericymba					
Stellifer zestocarus					
Ophioscion typicus					
Ophioscion simulus					
Ophioscion strabo	+				
Ophioscion imiceps					
Ophioscion scierus	+				
Sigmurus vermicularis					
Sciæna deliciosa				+	

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Micropogon altipinnis			+		
Umbrina xanti	+		+		
Umbrina dorsalis	+				
Menticirrhus nasus					
Menticirrhus panamensis	+				
Menticirrhus elongatus	+				
Polyclemus dumerili			+		
Polyclemus rathbuni					
Polyclemus goodei					
Paralonchurus petersi					
Eques viola					
Cirrhites rivulatus	+	+			
Chromis atrilobatus	+				
Pomacentrus rectifrænum	+		+		
Pomacentrus gilli					
Pomacentrus flavilatus	+				
Nexilarius concolor		+			
Glyphisodon saxatilis	+	+	+		+
Microspathodon dorsalis	+	+			
Harpe diplotænia	+	+			
Halichæres sellifer		+			
Halichæres macgregori					
Halichæres dispilus	+				
Pseudojulis notospilus	+	+	+		
Thalassoma lucasanum	+				
Pseudoscarus perrico	+	+			
Chætodipterus zonatus	+				
Parapsettus panamensis			+		
Chætodon nigrirostris	+	+			
Chætodon humeralis	+		+		
Pomacanthus zonipectus	+				

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Holacanthus passer	+	+	+		
Teuthis crestonis	+	+			
Balistes polylepis	+				
Balistes naufragium	+				
Balistes verres	+				
Xesurus hopkinsi					
Spheroides angusticeps	+	+			
Spheroides lobatus	+	+			
Spheroides testudineus					+
Spheroides annulatus	+	+	+		
Spheroides furthii					
Guentheridia formosa					
Tetraodon hispidus					
Eumycterias punctatissimus	+				
Diodon holacanthus	+				+
Scorpæna histrio		+			
Scorpæna pannosa					
Scorpæna mystes	+				
Scorpæna russula					
Prionotus xenisma	+				
Prionotus loxias					
Prionotus quiescens	+				
Prionotus albirostris	+				
Prionotus horrens	+				
Prionotus ruscarius	+				
Philypnus lateralis	+				
Dormitator maculatus	+				+
Eleotris pictus	+				
Alexurus armiger	+				
Gymneleotris seminudus					
Gobius soporator	+	+	+		+
Gobionellus sagittula	+				

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Gobionellus microdon	+				
Garmannia paradoxa	+				
Enypnias seminudus					
Bollmannia chlamydes					
Aboma lucretiae					
Microgobius emblematicus					
Microgobius miraflorensis					
Evermannia zosterura	+				
Evermannia panamensis					
Tyntlastes brevis					
Echeneis naucrates	+				+
Remora remora	+	+		+	+
Opisthognathus punctatum	+				
Dactyloscopus zelotes					
Kathetostoma averruncus					
Batrachoides pacifici			+		
Batrachoides boulengeri					
Porichthys margaritatus	+	+			
Porichthys greenei					
Thalassophryne reticulata					
Thalassophryne dowi					
Gobiesox rhodospilus			+		
Malacoctenus delalandi			+		+
Mnierpes macrocephalus	+				
Auchenopterus monophthalmus	+				
Hypsoblennius piersoni					
Hypsoblennius striatus					
Hypsoblennius brevipinnis	+		+		
Homesthes caulopus					
Scartichthys rubropunctatus					
Rupiscartes atlanticus	+	+	+		+
Emblemaria nivipes					+

Panama	Gulf of California	Galapagos Islands	Ecuador	Peru	Atlantic Ocean
Microdesmus dipus	+				
Microdesmus retropinnis					
Cerdale ionthas					
Lepophidium prorates					
Otophidium indefatigabile		+			
Fierasfer dubius					
Ogilbia ventralis	+				
Bregmaceros macclellandi					
Hippoglossina bollmani					
Paralichthys woolmanni	+				
Ancylopsetta dendritica	+				
Platophrys constellatus		+			
Engyophrys sancti-laurentii					
Syacium latifrons					
Syacium ovale	+				
Cyclopsetta querna					
Azevia panamensis	+				
Citharichthys platophrys					
Citharichthys gilberti	+		+		
Etropus crossotus	+				+
Achirus klunzingeri				+	
Achirus fonsecensis	+				
Achirus scutum					
Symphurus atramentatus	+	+			
Symphurus elongatus					
Symphurus atricaudus	+				
Symphurus leei					
Lophiomus caulinaris					
Antennarius strigatus	+				
Antennarius sanguineus	+				
Zalieutes elater	+				

BIBLIOGRAPHY.

1840–42. Jenyns, L. The zoology of the voyage of H. M. S. Beagle, under the command of Captain Fitzroy, R. N., during the years 1832 to 1836. Fish. 1840-42.

1860*a*. Gill, Theodore. Monograph of the genus *Labrosomus* Sw. *Proc. Acad. Nat. Sci. Phil.*, 1860, pp. 102-108.

1860*b*. Gill, Theodore. Monograph of the *Philypni*. *Proc. Acad. Nat. Sci. Phil.*, 1860, pp. 120-126.

1861*a*. Gill, Theodore. Description of a new species of the genus *Anableps* of Gronovius. *Proc. Acad. Nat. Sci. Phil.*, 1861, pp. 3-6.

1861*b*. Gill, Theodore. Synopsis generum *Rhytici* et affinium. *Proc. Acad. Nat. Sci. Phil.*, 1861, pp. 52-54.

1861*c*. Gill, Theodore. On several new generic types of fishes. *Proc. Acad. Nat. Sci. Phil.*, 1861, pp. 77-78.

1861*d*. Gill, Theodore. Monograph of the Tridigitate Uranoscopoids. *Proc. Acad. Nat. Sci. Phil.*, 1861, pp. 263-271.

1861*a*. Günther, Albert. On a collection of fishes sent by Captain Dow from the Pacific coast of Central America. *Proc. Zool. Soc. Lond.*, 1861, pp. 370-376.

1861*b*. Günther, Albert. Catalogue of the Acanthopterygian Fishes of the British Museum, Vol. III.

1861. Dow, John M. [Letter concerning *Anableps dowei*.] *Proc. Zool. Soc. Lond.*, 1861, p. 30.

1862. Gill, Theodore. Catalogue of the fishes of Lower California in the Smithsonian Institution, collected by Mr. J. Xantus. *Proc. Acad. Nat. Sci. Phil.*, 1862. Part I, pp. 140-151; Part II, pp. 242-246; Part III, pp. 249-262.

1862. Günther, Albert. Catalogue of the fishes of the British Museum. Vol. IV.

1863*a*. Gill, Theodore. Description of some new species of Pediculati, and on the classification of the group. *Proc. Acad. Nat. Sci. Phil.*, 1863, pp. 88-92.

1863*b*. Gill, Theodore. Descriptive enumeration of a collection of fishes from the western coast of Central America, presented to the Smithsonian Institution by Captain John M. Dow. *Proc. Acad. Nat. Sci. Phil.*, 1863, pp. 162-174.

1864. Kner, Rudolf, and Steindachner, Franz. Neue Gattungen und Arten von Fischen aus Central-Amerika. *Abhandl. k. bayer. Akad. Wissen.*, Vol. X, 1864, pp. 1-61.

1864*a*. Günther, Albert. Catalogue of the fishes of the British Museum, Vol. V.

1864*b*. Günther, Albert. On some new species of Central American fishes. *Proc. Zool. Soc. Lond.*, 1864, pp. 23-27. Also, *Ann. Mag. Nat. Hist.*, 3d Ser., Vol. XIV, 1864, pp. 227-232.

1864*c*. Günther, Albert. Report of a collection of fishes made by Messrs Dow, Godman and Salvin in Guatemala. *Proc. Zool. Soc. Lond.*, 1864, pp. 144-154.

1864d. Gunther, Albert. On a poison-organ in a genus of Batrachoid fishes. *Proc. Zool. Soc. Lond.*, 1864, pp. 155-158.

1865. Gill, Theodore. On a new generic type of sharks. *Proc. Acad. Nat. Sci. Phil.*, 1865, p. 177.

1865. Dow, John M. [Letter concerning examples of *Thalassophryne* obtained at Panama.] *Proc. Zool. Soc. Lond.*, 1865, p. 677.

1866a. Gunther, Albert. Catalogue of the fishes of the British Museum, Vol. VI.

1866b. Gunther, Albert. Memoir on the fishes of the states of Central America. *Proc. Zool. Soc. Lond.*, 1866, pp. 600-604.

1868. Steindachner, F. Ichthyologische Notizen (VII). *Sitzb. k. Akad. Wissen. Wien*, Vol. LVII, 1868, pp. 965-1008.

1868a. Bocourt, M. F. Note sur des poissons Percoïdes appartenant au genre *Centropome*, provenant du Mexique et de l'Amérique Centrale. *Ann. Sci. Nat.*, 5th Ser., Vol. IX 1868, pp. 90-91.

1868b. Bocourt, M. F. Descriptions de quelques Acanthoptérygiens nouveaux appartenant au genre *Serran* et *Mesoprion*, recueillis dans l'Amérique Centrale. *Ann. Sci. Nat.*, Vol. IX, 1868, pp. 222-224.

1869. Gunther, Albert. An account of the fishes of the states of Central America, based on collections made by Captain J. M. Dow, F. Godman, Esq., and O. Salvin, Esq. *Trans. Zool. Soc. Lond.*, 1869, pp. 377-494.

1869. Peters, W. Neue oder weniger bekannte Fische des Berliner Zoologischen Museums. *Monatsber. Königl. Akad. Wissen. Berlin*, 1869, pp. 703-711.

1869. Bocourt, M. Descriptions de quelques reptiles et poissons nouveaux appartenant a la faune tropicale de l'Amérique. Poissons de la famille des Scienoïdes. *Nouv. Arch. du Mus. d'Hist. Nat.*, Vol. V, 1869, pp. 21-24.

1870a. Steindachner, F. Ichthyologische Notizen (VIII). *Sitzb. k. Akad. Wissen. Wien*, Vol. LX, 1869 (1870), pp. 120-139.

1870b. Steindachner, F. Ichthyologische Notizen (IX). III. Über einige neue oder seltene Arten von Mazatlan, Lagos und Santos. *Sitzb. k. Acad. Wissen. Wien*, Vol. LX, 1869 (1870), pp. 305-315.

1870c. Steindachner, F. Ichthyologische Notizen (X). *Sitzb. k. Acad. Wissen. Wien*, Vol. LXI, 1870, pp. 623-642.

1870. Gunther, A. Catalogue of the fishes of the British Museum, Vol. VIII.

1871. Cope, E. D. Contribution to the ichthyology of the Lesser Antilles. *Trans. Am. Phil. Soc.*, Vol. XIV, 1871, pp. 445-483.

1874. Putnam, F. W. Notes on Ophidiidæ and Fierasferidæ, with descriptions of new species from America and the Mediterranean. *Proc. Bost. Soc. Nat. Hist.*, 1874, pp. 339-348.

1874. Vaillant, L., and Bocourt, M. Mission scientifique au Mexique et dans l'Amérique Centrale. 4th part. Études sur les poissons, 1874.

1875a. Steindachner, F. Ichthyologische Beiträge (I). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXX, 1874 (1875), pp. 375-390.

1875b. Steindachner, F. Ichthyologische Beiträge (II). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXI, 1875, pp. 443-480.

1875c. Steindachner, F. Ichthyologische Beiträge (III). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXII, 1875 (1876), pp. 29-96.

1876*b*. Steindachner, F. Ichthyologische Beiträge (IV). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXII, 1875 (1876), pp. 551–616.

1877. Steindachner, F. Ichthyologische Beiträge (V). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXIV, 1876 (1877), pp. 49–240.

1877. Streets, T. H. Contributions to the natural history of the Hawaiian Islands and Fanning Islands and Lower California. Fishes of Upper and Lower California. *Bull. U. S. Nat. Mus.*, No. 7, 1877, pp. 43-56.

1877. Gill, Theodore. Synopsis of the fishes of Lake Nicaragua. *Proc. Acad. Nat. Sci. Phil.*, 1877, pp. 175-191.

1878. Steindachner, F. Ichthyologische Beiträge (VI). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXVII, 1878, pp. 379-392.

1879*a*. Steindachner, F. Ueber einige neue und seltene Fisch-arten aus den k. k. Zoologischen Museen zu Wien, Stuttgart und Warschau. V. Beiträge zur Kenntniss der Meeresfische Süd-Amerika's. *Denkschr. k. Akad. Wissen. Wien*, Vol. XLI, 1879, pp. 28-44.

1879*b*. Steindachner, F. Ichthyologische Beiträge (VII). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXVIII, 1878 (1879), pp. 377-400.

1879*c*. Steindachner, F. Beiträge zur Kenntniss der Flussfische Sudamerika's. II. Ueber eine Sammlung von Fischen aus dem Mamoni-Flusse bei Chepo. *Denkschr. k. Akad. Wissen. Wien*, Vol. XLI, 1879, pp. 159-169.

1880. Lockington, W. N. Description of a new Sparoid fish (*Sparus brachysomus*), from Lower California. *Proc. U. S. Nat. Mus.*, Vol. III, 1880, pp. 284-286.

1880*a*. Steindachner, F. Zur Fisch-fauna des Cauca und der Flüsse bei Guayaquil. *Denksch. k. Akad. Wissen. Wien*, Vol. XLII, 1880, pp. 55-104.

1880*b*. Steindachner, F. Ichthyologische Beiträge (VIII). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXX, 1879 (1880), pp. 119-191.

1881. Lockington, W. N. List of the fishes collected by Mr. W. J. Fisher upon the coasts of Lower California, 1876-77, with descriptions of new species. *Proc. Acad. Nat. Sci. Phil.*, 1881, pp. 113-120.

1881. Steindachner, F. Ichthyologische Beiträge (X). *Sitzb. k. Akad. Wissen. Wien*, Vol. LXXXIII, 1881, pp. 179-219.

1881*a*. Jordan, D. S., and Gilbert, C. H. Notes on a collection of fishes made by Lieut. Henry E. Nichols, U. S. N., on the west coast of Mexico, with descriptions of new species. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, pp. 225-233.

1881*b*. Jordan, D. S., and Gilbert, C. H. List of fishes collected by Lieut. Henry E. Nichols, U. S. N., in the Gulf of California and on the west coast of Lower California, with descriptions of four new species. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, pp. 273-279.

1881*c*. Jordan, D. S., and Gilbert, C. H. Descriptions of thirty-three new species of fishes from Mazatlan, Mexico. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, pp. 338-365.

1881*d*. Jordan, D. S., and Gilbert, C. H. Description of a new species of *Pomadasys* from Mazatlan, with a key to the species known to inhabit the Pacific coasts of tropical America. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, pp. 383-388.

1881*e*. Jordan, D. S., and Gilbert, C. H. Description of a new species of *Xenichthys* (*Xenichthys xenurus*) from the west coast of Central America. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, p. 454.

1881*f*. Jordan, D. S., and Gilbert, C. H. Description of five new species of fishes from Mazatlan, Mexico. *Proc. U. S. Nat. Mus.*, Vol. IV, 1881, pp. 458-463.

1882. Gilbert, C. H. List of fishes observed at Punta Arenas, on the Pacific coast of Central America. *Bull. U. S. Fish Com.*, Vol. II, 1882, p. 112.

1882*a*. Jordan, D. S., and Gilbert, C. H. Descriptions of nineteen new species of fishes from the Bay of Panama. *Bull. U. S. Fish Com.*, Vol. I, 1881 (1882), pp. 306-335.

1882*b*. Jordan, D. S., and Gilbert, C. H. A review of the Siluroid fishes found on the Pacific coast of tropical America, with descriptions of three new species. *Bull. U. S. Fish Com.*, Vol. II, 1882, pp. 34-54.

1882*c*. Jordan, D. S., and Gilbert, C. H. List of fishes collected at Mazatlan, Mexico, by Charles H. Gilbert. *Bull. U. S. Fish Com.*, Vol. II, 1882, pp. 105-108.

1882*d*. Jordan, D. S., and Gilbert, C. H. List of fishes collected at Panama by Charles H. Gilbert. *Bull. U. S. Fish Com.*, Vol. II, 1882, pp. 109-111.

1882*e*. Jordan, D. S., and Gilbert, C. H. Descriptions of four new species of sharks, from Mazatlan, Mexico. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 102-110.

1882*f*. Jordan, D. S., and Gilbert, C. H. Description of a new species of *Conodon* (*Conodon serrifer*) from Boca Soledad, Lower California. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 351-352.

1882*g*. Jordan, D. S., and Gilbert, C. H. Catalogue of the fishes collected by Mr. John Xantus at Cape San Lucas, which are now in the U. S. National Museum, with descriptions of eight new species. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 353-371.

1882*h*. Jordan, D. S., and Gilbert, C. H. List of fishes collected by Mr. John Xantus at Colima, Mexico. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 371-372.

1882*i*. Jordan, D. S., and Gilbert, C. H. List of fishes collected at Panama by Capt. John M. Dow, now in the United States National Museum. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 373-378.

1882*k*. Jordan, D. S., and Gilbert, C. H. List of a collection of fishes made by Mr. L. Belding near Cape San Lucas, Lower California. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 378-381.

1882*l*. Jordan, D. S., and Gilbert, C. H. List of fishes collected at Panama by Rev. Mr. Rowell, now preserved in the United States National Museum. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 381-382.

1882*m*. Jordan, D. S., and Gilbert, C. H. Description of a new species of *Urolophus* (*Urolophus asterias*) from Mazatlan and Panama. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 579-580.

1882*n*. Jordan, D. S., and Gilbert, C. H. List of fishes now in the Museum of Yale College, collected by Professor Frank H. Bradley, at Panama, with descriptions of three new species. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 620-632.

1882*o*. Jordan, D. S., and Gilbert, C. H. Descriptions of two new species of fishes (*Myrophis vafer* and *Chloroscombrus orqueta*) from Panama. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 645-647.

1882*p*. Jordan, D. S., and Gilbert, C. H. Description of a new eel (*Sidera castanea*) from Mazatlan, Mexico. *Proc. U. S. Nat. Mus.*, Vol. V, 1882, pp. 647-648.

1883. Jordan, D. S. Notes on the American fishes preserved in the Museums of Berlin, London, Paris and Copenhagen. *Proc. Acad. Nat. Sci. Phil.*, 1883, pp. 281-293.

1883. JORDAN, D. S., and GILBERT, C. H. Description of a new species of *Rhinobatus* (*Rhinobatus glaucostigma*) from Mazatlan, Mexico. *Proc. U. S. Nat. Mus.*, Vol. VI, 1883, pp. 210-211.

1884. GRANT, W. R. OGILVIE- A revision of the fishes of the genera *Sicydium* and *Lentipes*, with descriptions of five new species. *Proc. Zool. Soc. Lond.*, 1884, pp. 153-172.

1884. JORDAN, D. S. Notes on the fishes collected at Guaymas, Mexico, by Mr. H. F. Emeric, with a description of *Gobiosoma histrio*, a new species. *Proc. U. S. Nat. Mus.*, Vol. VII, 1884, pp. 260-261.

1884. JORDAN, D. S., and GILBERT, C. H. Description of *Sciæna sciera*, a new species of *Sciæna* from Mazatlan and Panama. *Proc. U. S. Nat. Mus.*, Vol. VII, 1884, pp. 480-482.

1884*a*. JORDAN, D. S., and SWAIN, JOSEPH. A review of the American species of *Epinephelus* and related genera. *Proc. U. S. Nat. Mus.*, Vol. VII, 1884, pp. 358-410.

1884*b*. JORDAN, D. S., and SWAIN, JOSEPH. A review of the species of Lutjaninæ and Hoplopagrinæ found in American waters. *Proc. U. S. Nat. Mus.*, Vol. VII, 1884, pp. 427-474.

1884. MEEK, SETH E. A review of the American species of the genus *Synodus*. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 130-136.

1884*a*. MEEK, S. E., and NEWLAND, R. G. A review of the American species of the genus *Sphyræna*. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 67-75.

1884*b*. MEEK, S. E., and NEWLAND, R. G. A review of the American species of *Scomberomorus*. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 232-235.

1884. MEEK, S. E., and HOFFMAN, M. L. A review of the American species of the genus *Teuthis*. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 227-231.

1884*a*. MEEK, S. E., and GOSS, D. K. A review of the American species of the genus *Trachynotus*. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 121-129.

1884*b*. MEEK, S. E., and GOSS, D. K. A review of the American species of *Hemirhamphus*. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 221-226.

1884. FORDICE, M. W. A review of the American species of Stromateidæ. *Proc. Acad. Nat. Sci. Phil.*, 1884, pp. 311-317.

1885. MEEK, S. E., and HALL, E. A. A review of the American genera and species of Batrachidæ. *Proc. Acad. Nat. Sci. Phil.*, 1885, pp. 52-62.

1885. HALL, E. A., and MC CAUGHAN, J. Z. A. A review of the American genera and species of Mullidæ. *Proc. Acad. Nat. Sci. Phil.*, 1885, pp. 149-155.

1885. JORDAN, D. S. A list of the fishes known from the Pacific coast of tropical America, from the Tropic of Cancer to Panama. *Proc. U. S. Nat. Mus.*, Vol. VIII, 1885, pp. 361-394.

1885. EIGENMANN, C. H., and FORDICE, M. W. A review of the American Eleotridinæ. *Proc. Acad. Nat. Sci. Phil.*, 1885, pp. 66-80.

1885. GARMAN, S. Notes and descriptions taken from Selachians in the U. S. National Museum. *Proc. U. S. Nat. Mus.*, Vol. VIII, 1885, pp. 39-44.

1886. JORDAN, D. S., and EDWARDS, C. L. A review of the American species of Tetraodontidæ. *Proc. U. S. Nat. Mus.*, Vol. IX, 1886, pp. 230-247.

1886. JORDAN, D. S., and HUGHES, ELIZABETH G. A review of the species of the genus *Prionotus*. *Proc. U. S. Nat. Mus.*, Vol. IX, 1886, pp. 327-338.

1886 Evermann, B. W., and Meek, S. E. A revision of the American species of the genus *Gerres*. *Proc. Acad. Nat. Sci. Phil.*, 1886, pp. 256-272.

1887. Jordan, D. S., and Gilbert, C. H. Description of a new species of *Thalassophryne* (*Thalassophryne dowi*) from Punta Arenas and Panama. *Proc. U. S. Nat. Mus.*, Vol. X, 1887, p. 388.

1888. Eigenmann, C. H., and Eigenmann, R. S. A list of the American species of Gobiidæ and Callionymidæ, with notes on the specimens contained in the Museum of Comparative Zoology, at Cambridge, Massachusetts. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. I, 1888, pp. 51-78.

1888-89. Eigenmann, C. H., and Eigenmann, R. S. Preliminary notes on South American Nematognathi, I, II. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. I, 1888, pp. 119-172; Vol. II, 1889, pp. 28-56.

1888. Jordan, D. S. List of fishes collected by Alphonse Forrer about Mazatlan, with descriptions of two new species—*Heros beani* and *Pœcilia butleri*. *Proc. U. S. Nat. Mus.*, Vol. II, 1888, pp. 329-334.

1888. Jenkins, O. P., and Evermann, B. W. Descriptions of eighteen new species of fishes from the Gulf of California. *Proc. U. S. Nat. Mus.*, Vol. II, 1888, pp. 137-158.

1889. Morrison, W. L. A review of the American species of Priacanthidæ. *Proc. Acad. Nat. Sci. Phil.*, 1889, pp. 159-163.

1889. Kirsch, P. H. A review of the European and American Uranoscopidæ or Star-gazers. *Proc. Acad. Nat. Sci. Phil.*, 1889, pp. 258-265.

1889. Jordan, D. S., and Bollman, C. H. Descriptions of new species of fishes collected at the Galapagos Islands and along the coast of the United States of Colombia, 1887-88. *Proc. U. S. Nat. Mus.*, Vol. XII, 1889, pp. 149-183.

1889. Jordan, D. S., and Eigenmann, C. H. A review of the Sciænidæ of America and Europe. *Rep't. U. S. Com'r Fish and Fisheries*, 1886 (1889), pp. 343-451.

1889. Jordan, D. S., and Goss, D. K. A review of the flounders and soles (Pleuronectidæ) of America and Europe. *Rep't. U. S. Com'r Fish and Fisheries*, 1886 (1889), pp. 225-342.

1890. Jordan, D. S., and Eigenmann, C. H. A review of the genera and species of Serranidæ found in the waters of America and Europe. *Bull. U. S. Fish Com.*, Vol. VIII, 1888 (1890), pp. 329-433.

1890. Kirsch, P. H. A review of the American species of Thread-fins (Polynemidæ). *Ann. N. Y. Acad. Sci.*, Vol. V, 1890, pp. 231-236.

1890*a*. Gilbert, C. H. A preliminary report on the fishes collected by the steamer Albatross on the Pacific coast of North America during the year 1889, with descriptions of twelve new genera and ninety-two new species. *Proc. U. S. Nat. Mus.*, Vol. XIII, 1890, pp. 49-126.

1890*b*. Gilbert, C. H. A supplementary list of fishes collected at the Galapagos Islands and Panama, with descriptions of one new genus and three new species. *Proc. U. S. Nat. Mus.*, Vol. XIII, 1890, pp. 449-455.

1890. Eigenmann, C. H., and Eigenmann, R. S. A revision of the South American Nematognathi or cat-fishes. *Occas. Papers, Cal. Acad. Sci.*, I, 1890.

1891. Jordan, D. S. A review of the Labroid fishes of America and Europe. *Rep't. U. S. Com'r Fish and Fisheries*, 1887 (1891), pp. 599-699.

1891*a*. Gilbert, C. H. Description of Apodal fishes from the tropical Pacific. *Proc. U. S. Nat. Mus.*, Vol. XIV, 1891, pp. 347-552.

1891*b*. Gilbert, C. H. Description of thirty-four new species of fishes collected in 1888 and 1889, principally among the Santa Barbara Islands and in the Gulf of California. *Proc. U. S. Nat. Mus.*, Vol. XIV, 1891, pp. 539-566.

1891. Evermann, B. W., and Jenkins, O. P. Report upon a collection of fishes made at Guaymas, Sonora, Mexico, with descriptions of new species. *Proc. U. S. Nat. Mus.*, Vol. XIV, 1891, pp. 121-165.

1892. Jordan, D. S., and Davis, B. M. A preliminary review of the Apodal fishes or eels inhabiting the waters of America and Europe. *Rep't U. S. Com'r Fish and Fisheries*, 1888 (1892), pp. 581-677.

1893. Jordan, D. S., and Fesler, B. A review of the Sparoid fishes of America and Europe. *Rep't U. S. Com'r Fish and Fisheries*, 1889-1891 (1893), pp. 421-544.

1894. Vaillant, Léon. Sur une collection de poissons recueillis en Basse-Californie et dans le Golfe par M. Léon Diguet. *Bull. Soc. Philom. Paris*, 3rd Ser., Vol. VI, 1894, pp. 2-8.

1894. Eigenmann, C. H. Notes on some South American fishes. *Ann. N. Y. Acad. Sci.*, Vol. VII, 1894, pp. 625-637.

1895*a*. Jordan, D. S. Description of *Evermannia*, a new genus of Gobioid fishes. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. IV, 1892-1894 (1895), p. 592.

1895*b*. Jordan, D. S. The fishes of Sinaloa. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. V, 1895, pp. 378-514.

1895. Boulenger, G. A. Catalogue of the Perciform fishes in the British Museum, Vol. I.

1895. Faxon, Walter. Reports of an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross", during 1891, Lieut.-Commander Z. L. Tanner, commanding. XV. The Stalk-eyed Crustacea. *Mem. Mus. Comp. Zool. Harvard College*, Vol. XVIII, 1895, pp. 1-292.

1895. Gregory, J. W. Contributions to the Palæontology and Physical Geology of the West Indies. *Quart. Journ. Geol. Soc.*, Vol. LI, 1895, pp. 255-312.

1896. Jordan, D. S. Notes on fishes, little known or new to science. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. VI, 1896, pp. 201-244.

1896. Jordan, D. S., and Starks, E. C. Description of a new species of Pipe-fish (*Siphostoma sinaloæ*) from Mazatlan. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. VI, 1896, p. 268.

1896. Jordan, D. S., and Evermann, B. W. The fishes of North and Middle America. Part I. *Bull. U. S. Nat. Mus.*, No. 47.

1896. Gilbert, C. H. Descriptions of twenty-two new species of fishes collected by the steamer Albatross, of the United States Fish Commission. *Proc. U. S. Nat. Mus.*, Vol. XIX, 1896, pp. 437-457.

1896. Rutter, Cloudsley. Notes on fresh-water fishes of the Pacific Slope of North America. III. Note on a collection of fishes made in streams near Cape San Lucas by Dr. Gustav Eisen. *Proc. Cal. Acad. Sci.*, 2nd Ser., Vol. VI, 1896, pp. 263-266.

1898. Evermann, B. W. Notes on fishes collected by E. W. Nelson on the Tres Marias Islands and in Sinaloa and Jalisco, Mexico. *Proc. Biol. Soc. Wash.*, Vol. XII, 1898, pp. 1-3.

1898. Jordan, D. S., and Evermann, B. W. The fishes of North and Middle America. Parts II and III. *Bull. U. S. Nat. Mus.*, No. 47.

1898. Ogilby, J. Douglas- New genera and species of fishes. *Proc. Linn. Soc. N. S. W.*, Vol. XXVIII, 1898, pp. 280-299.

1898-9. Boulenger, G. A. Viaggio del Dr. Enrico Festa nel l'Ecuador e regione vicine. Poissons de l'Équateur. *Boll. Mus. Zool. Anat. comp. Torino*, Vol. XIII, 1898, pp. 1-13; Vol. XIV, 1899, pp. 1-8.

1899. Greene, C. W. The phosphorescent organs in the Toad-fish *Porichthys notatus* Girard. *Journ. Morph.*, Vol. XV, 1899, pp. 667-696.

1899. Jordan, D. S., and McGregor, R. C. List of fishes collected at the Revillagigedo Archipelago and neighboring islands. *Rep't U. S. Com'r Fish and Fisheries*, 1898 (1899), pp. 273-284.

1899. Garman, Samuel. Reports of an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer "Albatross," during 1891, Lieutenant-Commander Z. L. Tanner, U. S. N., commanding. XXVI. The Fishes. *Mem. Mus. Comp. Zool. Harvard College*, Vol. XXIV, 1889, pp. 1-431.

1899. Boulenger, G. A. Viaggio del Dott. Enrico Festa nel Darien e regioni vicine. Poissons de l'Amérique Centrale. *Boll. Zool. Anat. comp. Torino*, Vol. XIV, 1899, pp. 1-4.

1899*a*. Abbott, J. F. The marine fishes of Peru. *Proc. Acad. Nat. Sci. Phil.*, 1899, pp. 324-364.

1899*b*. Abbott, J. F. Notes on Chilean fishes, with description of a new species of *Sebastodes*. *Proc. Acad. Nat. Sci. Phil.*, 1899, pp. 475-477.

1900. Jordan, D. S., and Evermann, B. W. The fishes of North and Middle America. Part IV. *Bull. U. S. Nat. Mus.*, No. 47.

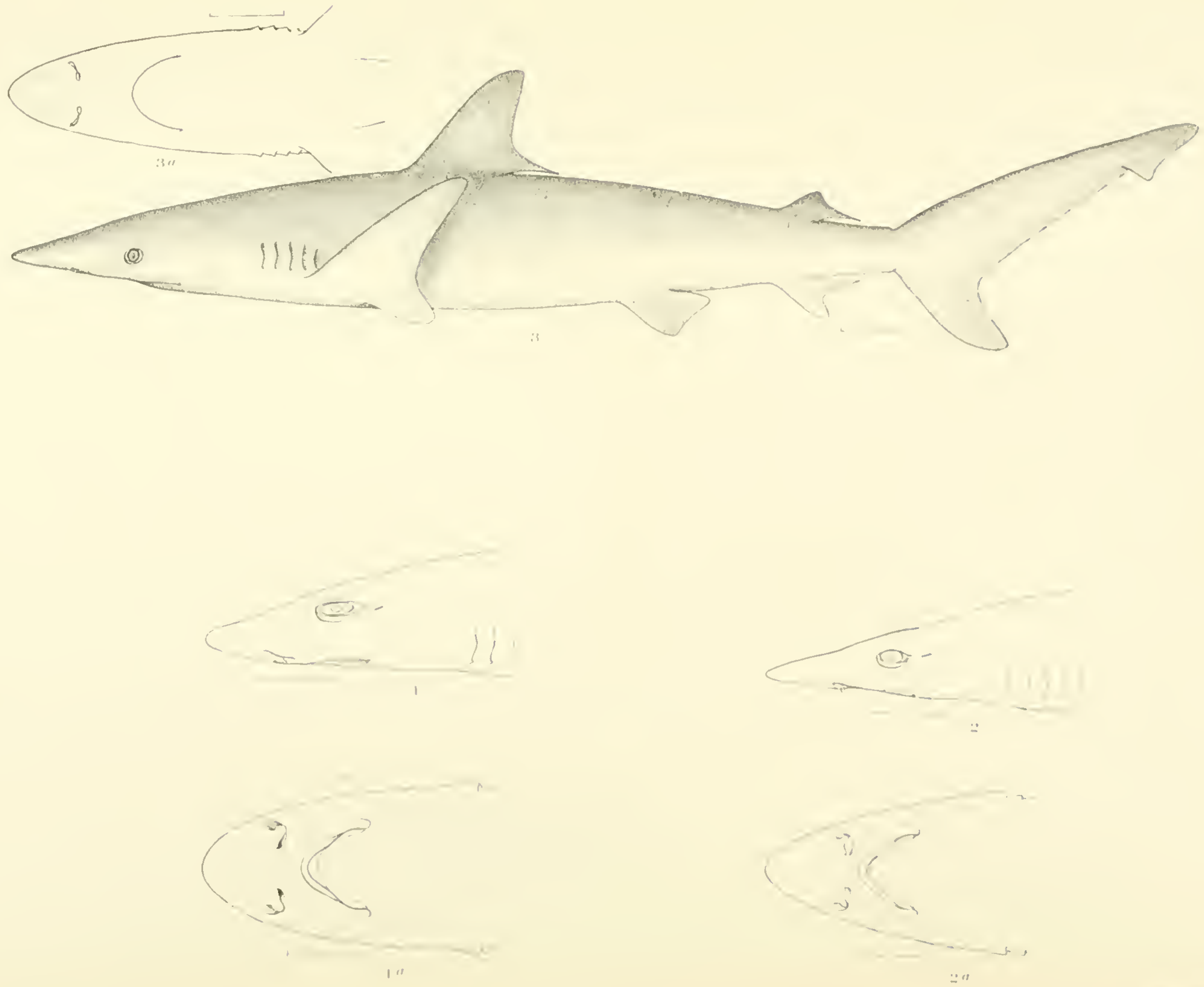
1901*a*. Pellegrin, J. Poissons recueillis par M. L. Diguet dans le Golfe de Californie. *Bull. Mus. d'Hist. Nat. Paris*, 1901, pp. 160-167.

1901*b*. Pellegrin, J. Poissons recueillis par M. L. Diguet dans l'État de Jalisco. *Bull. Mus. d'Hist. Nat. Paris*, 1901, pp. 204-207.

1903. Heller, E., and Snodgrass, R. E. Papers from the Hopkins Stanford Galapagos Expedition, 1898-1899. XV. New fishes. *Proc. Wash. Acad. Sci.*, Vol. V, 1903, pp. 189-229.

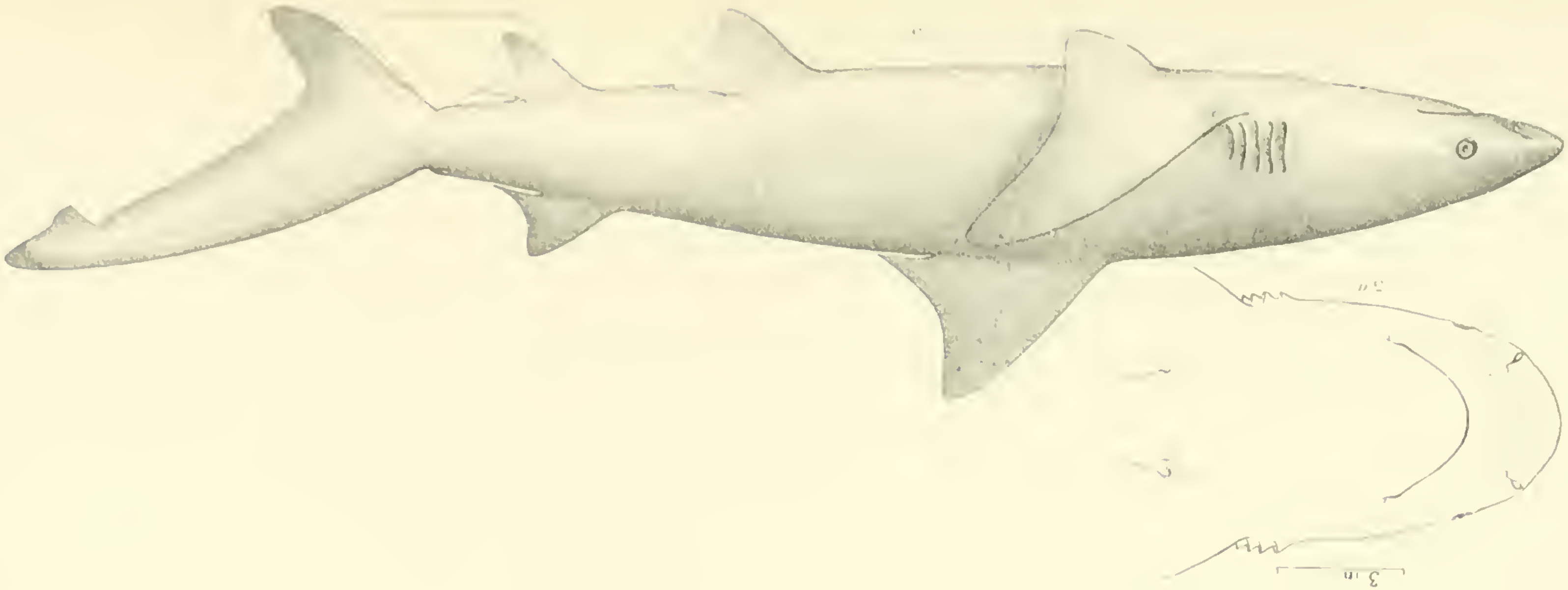
EXPLANATION OF PLATE I.

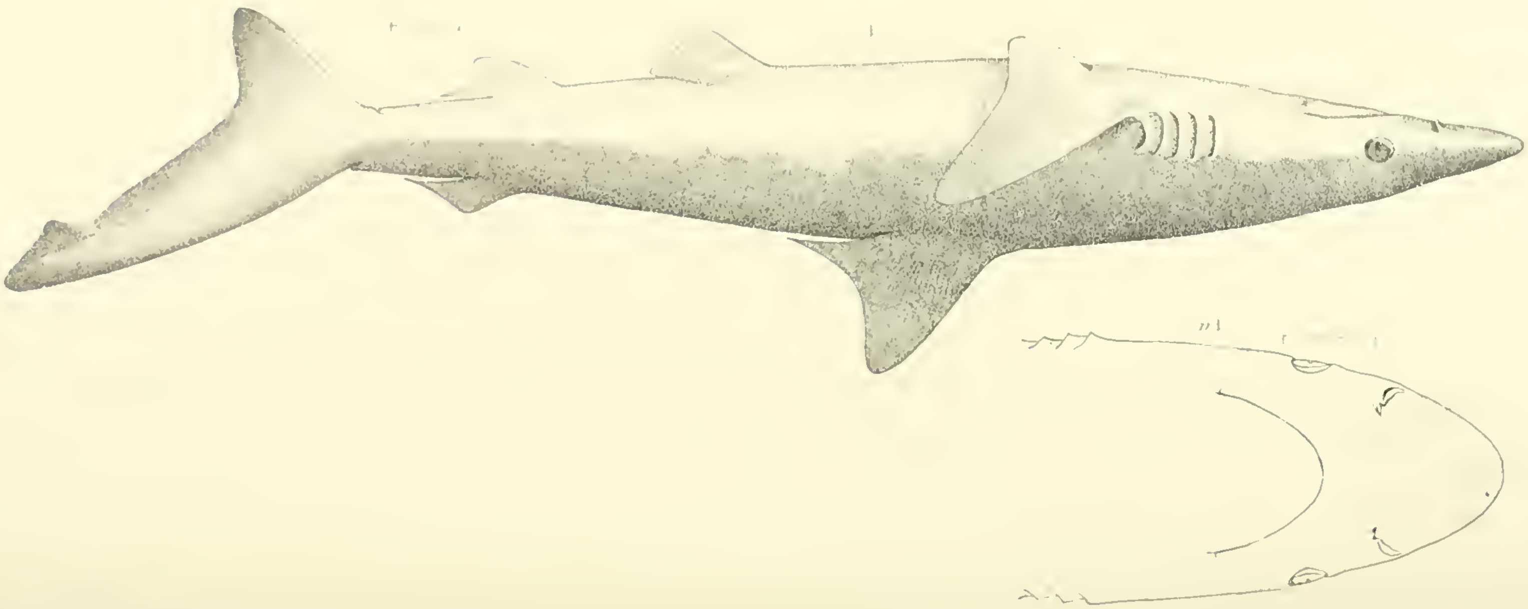
		PAGE
Figs. 1, 1*a*.	*Mustelus lunulatus* JORDAN & GILBERT. Panama.	5
Figs. 2, 2*a*.	*Galeus dorsalis* GILL. Panama.	7
Figs. 3, 3*a*.	*Carcharias velox* GILBERT. Type specimen; Panama.	9


3a
3
1
2
1a
2a

EXPLANATION OF PLATE II.

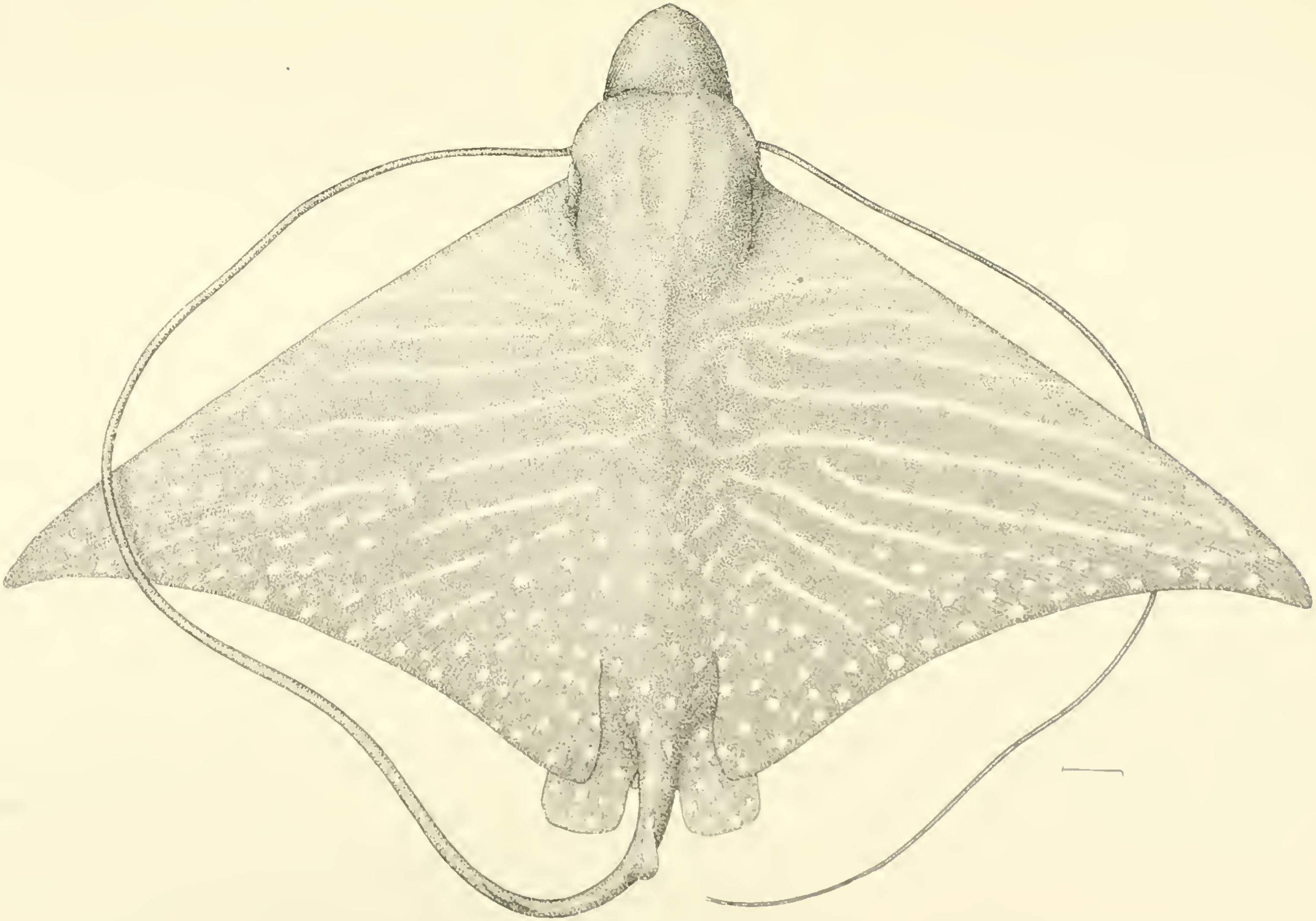
	PAGE
Figs. 4, 4*a*. *Carcharias cerdale* GILBERT. Type specimen; Panama.	10
Figs. 5, 5*a*. *Carcharias azureus* GILBERT & STARKS. Type specimen; Panama.	11


3 in



EXPLANATION OF PLATE III.

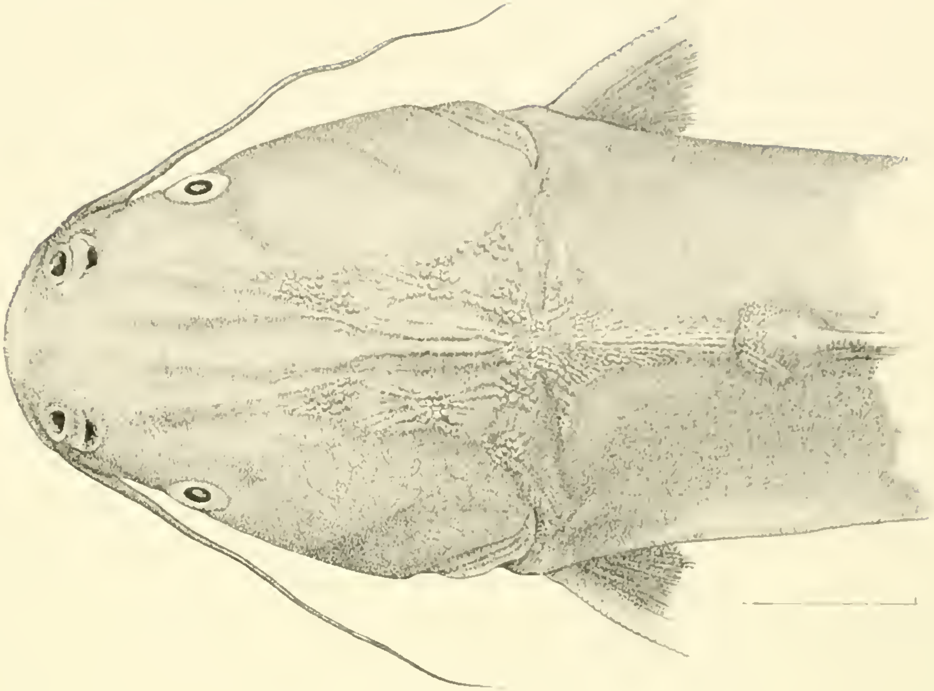
	PAGE
Fig. 6. *Myliobatis asperrimus* GILBERT. Type specimen; Panama.	19



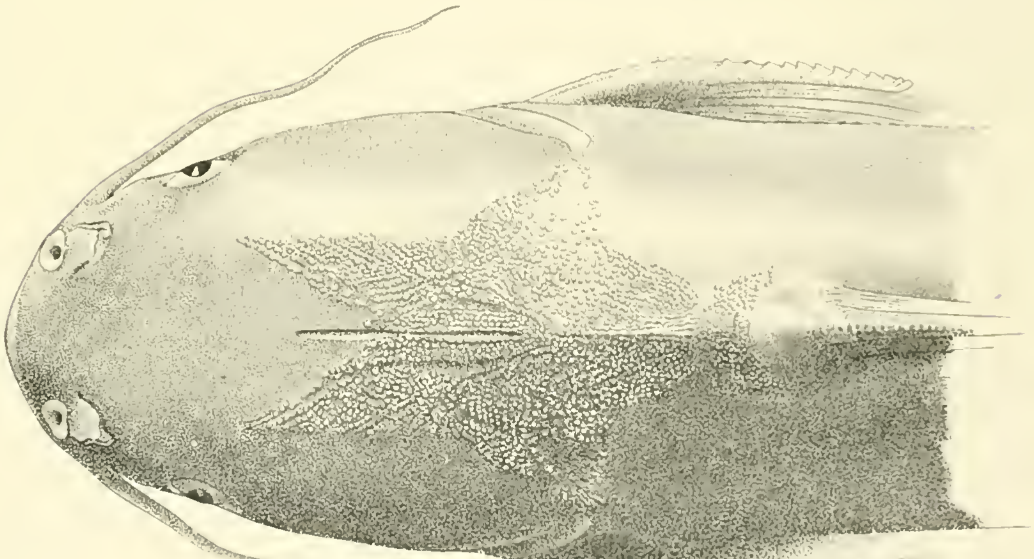
6

EXPLANATION OF PLATE IV.

	PAGE
Fig. 7. *Galeichthys xenauchen* GILBERT. Type specimen; Panama.	24
Fig. 8. *Galeichthys eigenmanni* GILBERT & STARKS. Type specimen; Panama.	21



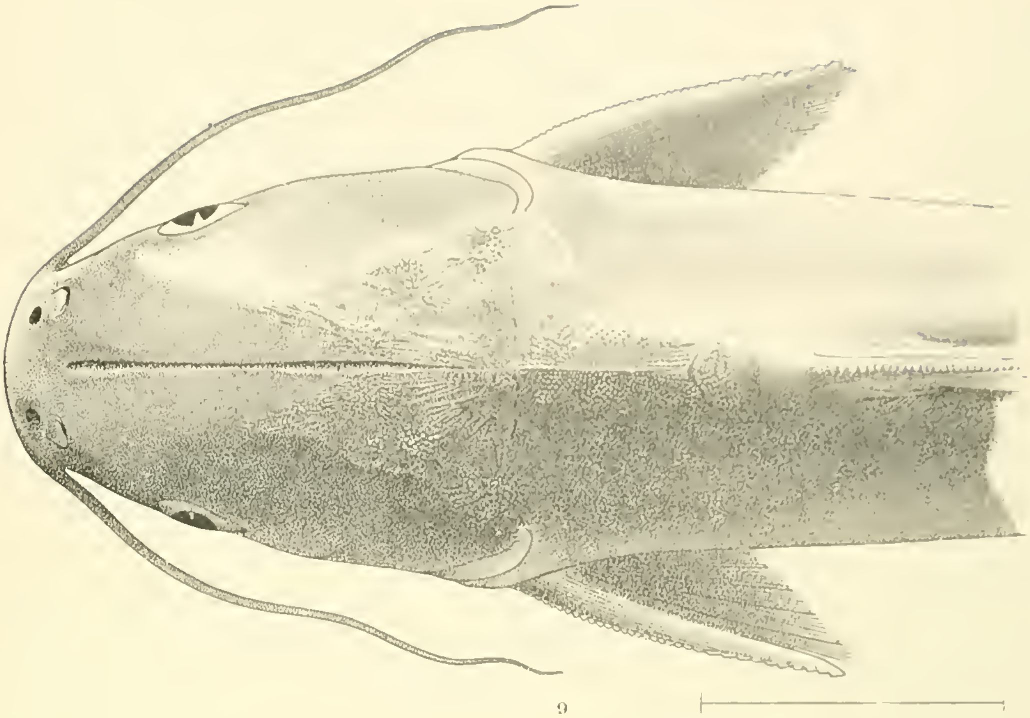
7

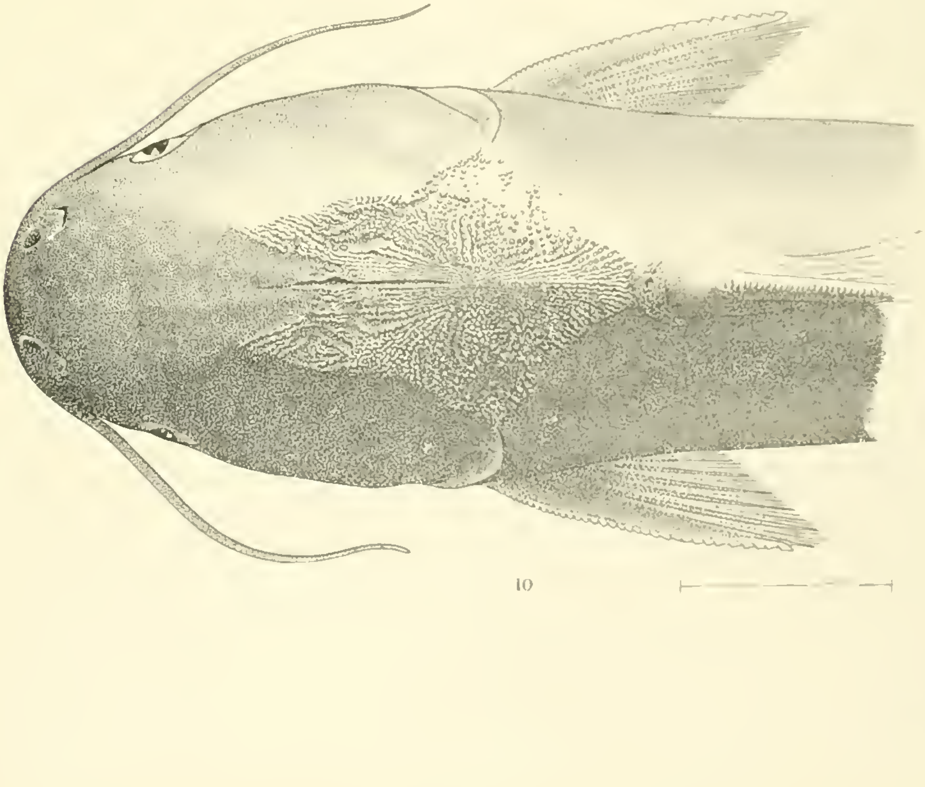


8

EXPLANATION OF PLATE V.

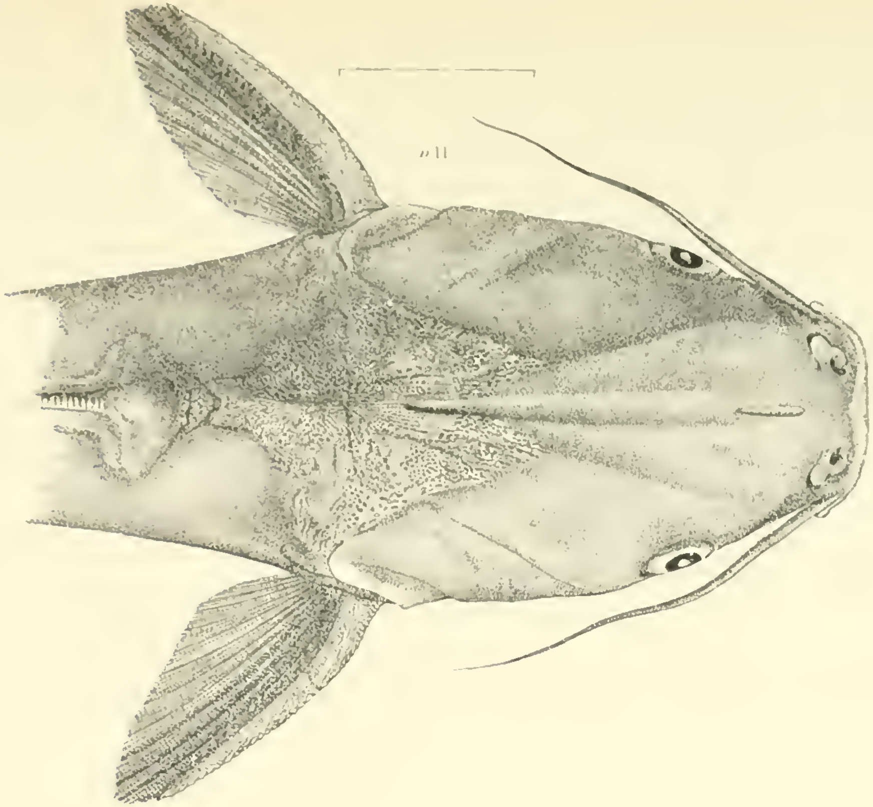
		PAGE
Fig. 9.	*Tachysurus steindachneri* GILBERT & STARKS. Type specimen; Panama.	29
Fig. 10.	*Tachysurus evermanni* GILBERT & STARKS. Type specimen; Panama.	32

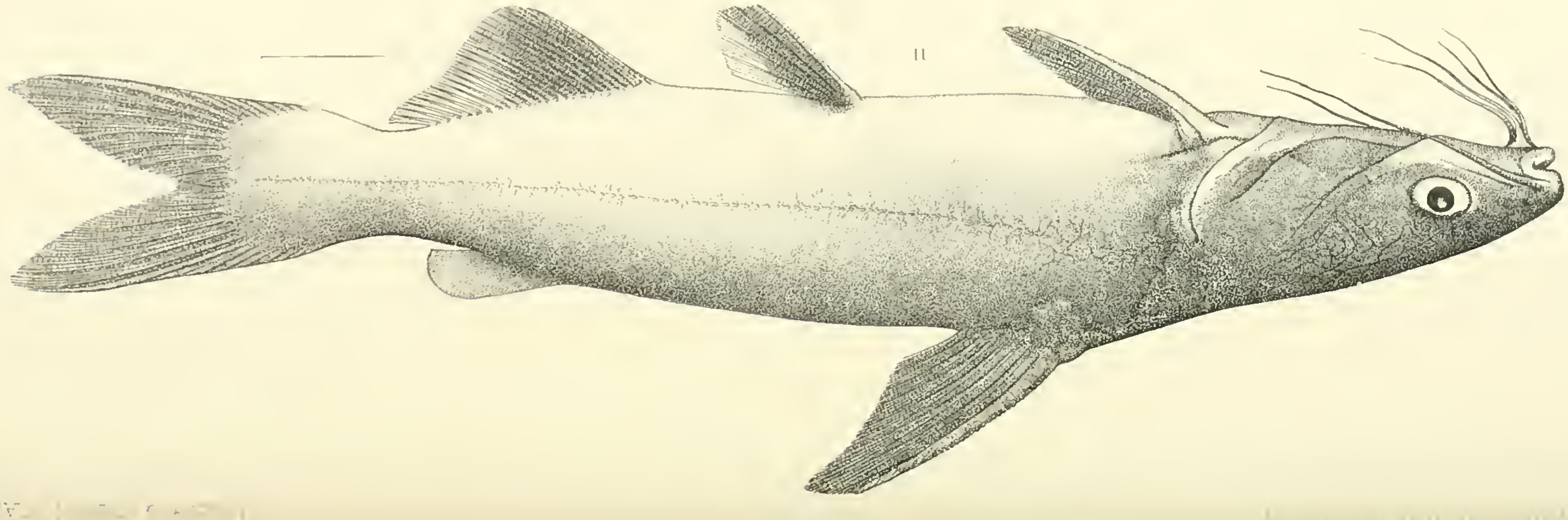

9


10

EXPLANATION OF PLATE VI.

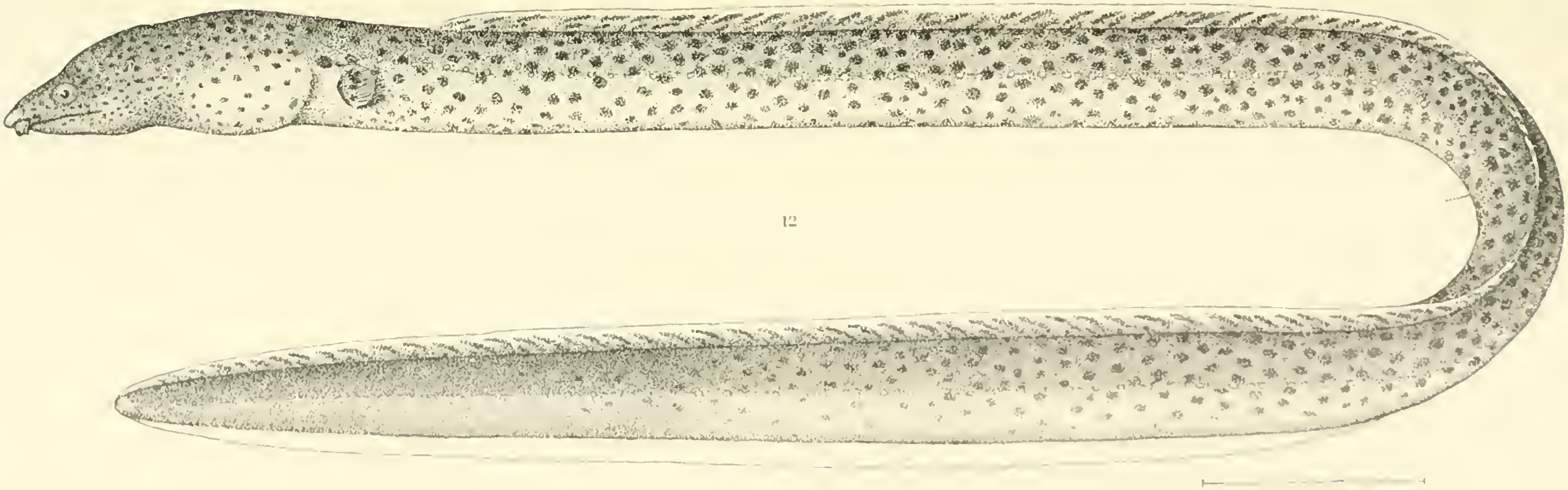
	PAGE
Figs. 11, 11*a*. *Tachysurus emmelane* GILBERT. Type specimen; Panama.	31


11a

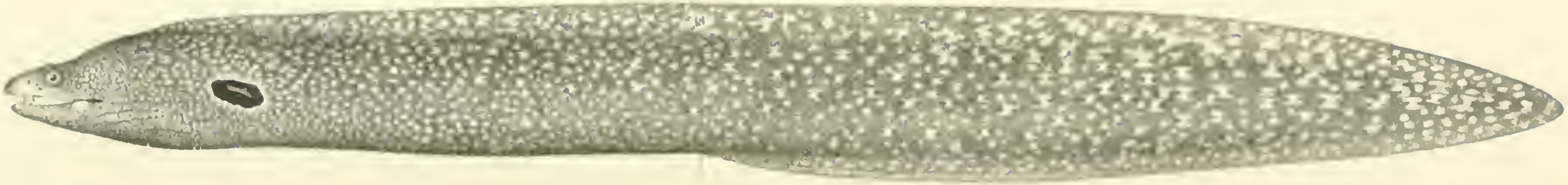

11

EXPLANATION OF PLATE VII.

	PAGE
Fig. 12. *Pisoodonophis daspilotus* GILBERT. Type specimen; Panama.	36
Fig. 13 *Muræna clepsydra* GILBERT. Type specimen; Panama.	38



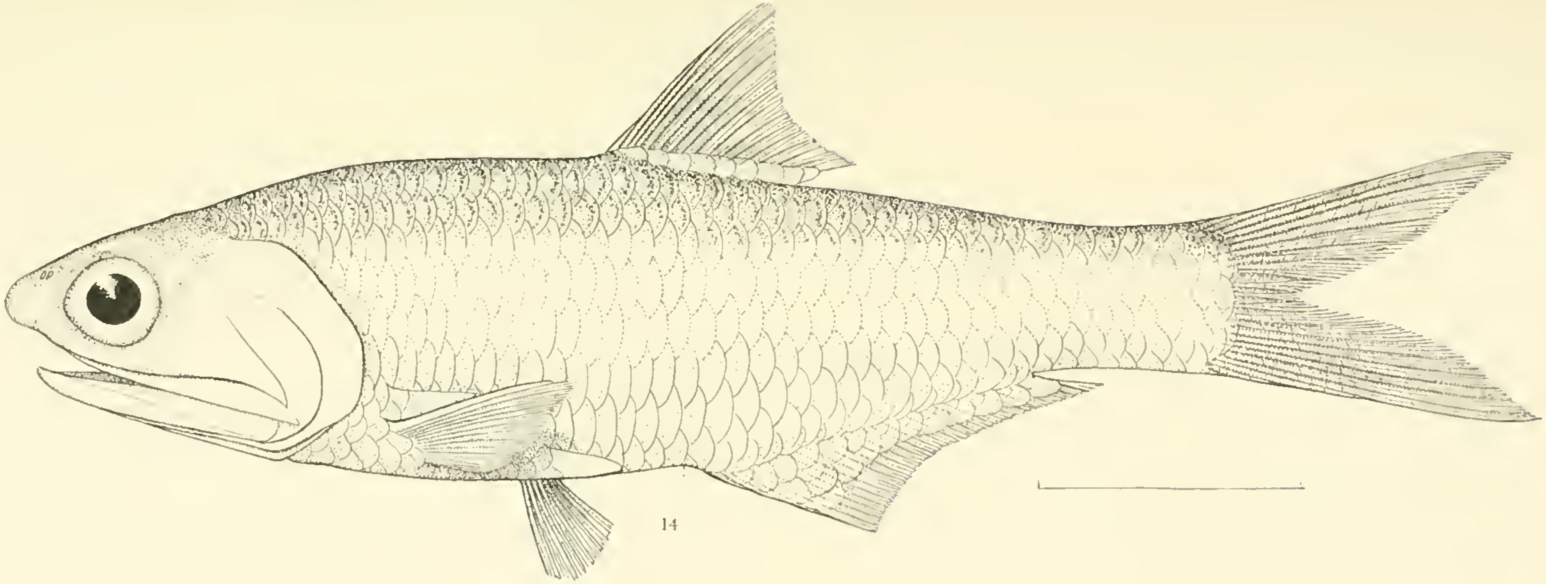
12



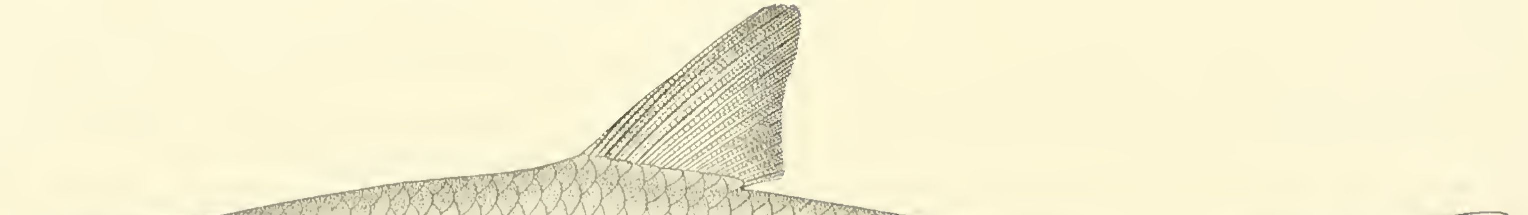
13

EXPLANATION OF PLATE VIII.

	PAGE
Fig. 14. *Anchovia rastralis* GILBERT & PIERSON. Type specimen; Panama.	42
Fig. 15. *Anchovia spinifera* CUVIER & VALENCIENNES. Panama.	46



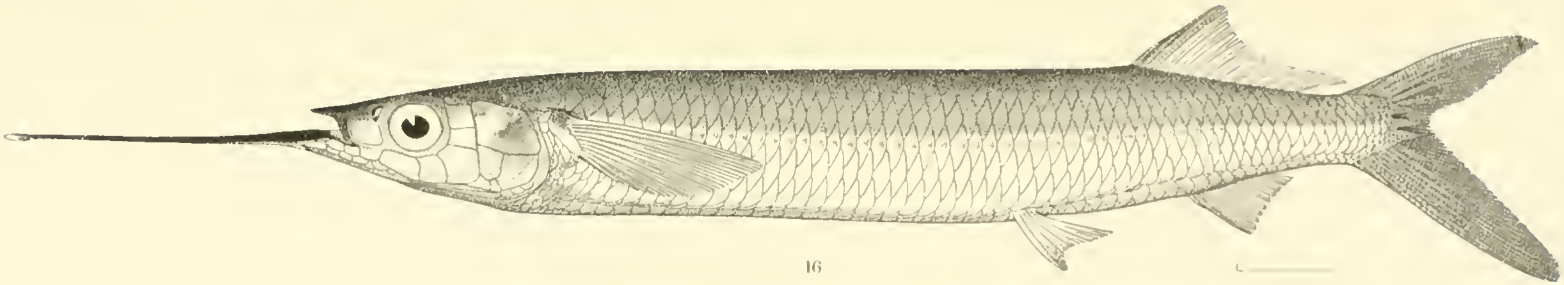
14



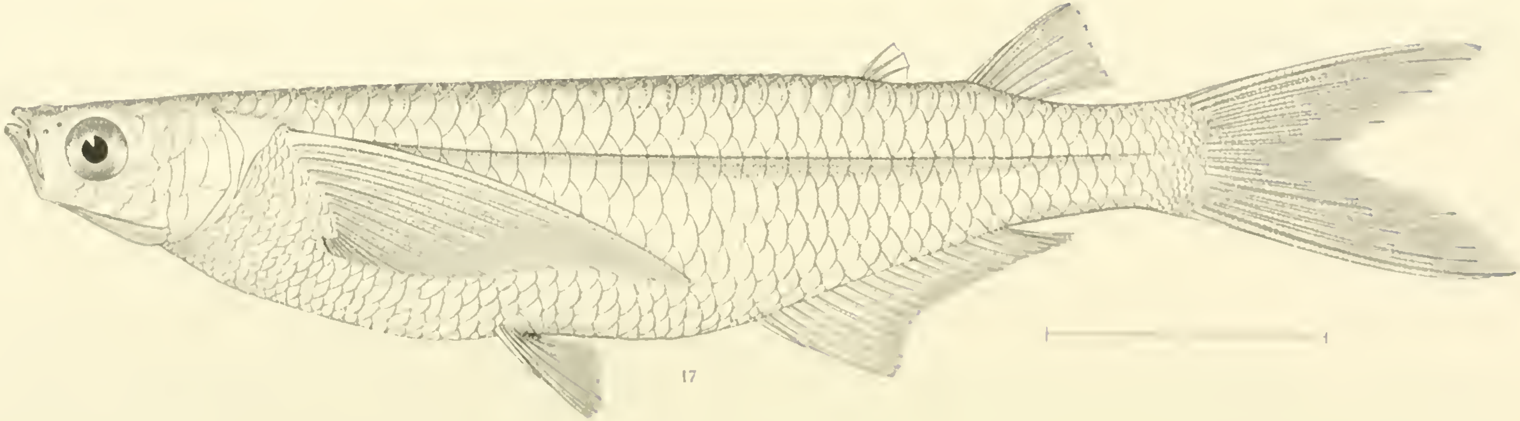
15

EXPLANATION OF PLATE IX.

		PAGE
Fig 16.	*Hemirhamphus saltator* GILBERT & STARKS. Type specimen; Panama.	53
Fig. 17.	*Atherinella panamensis* STEINDACHNER. Panama.	59



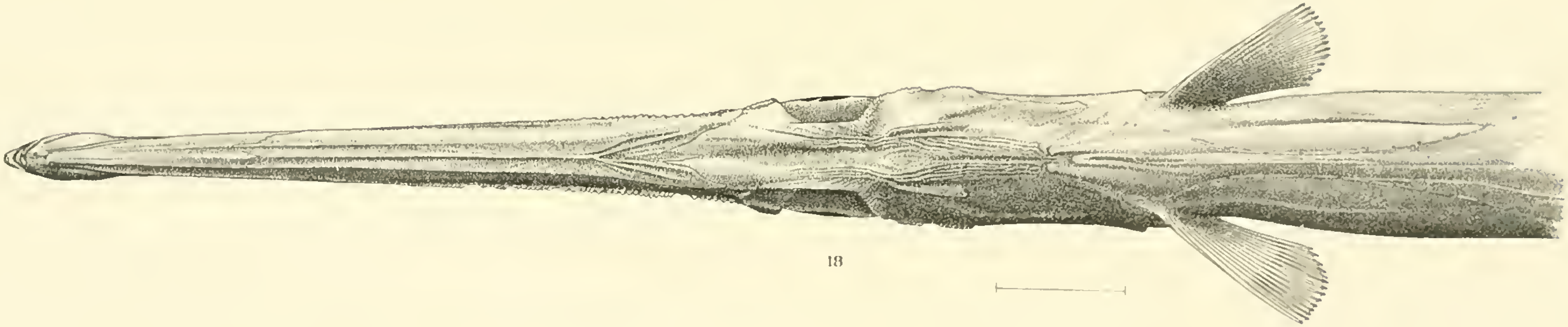
16



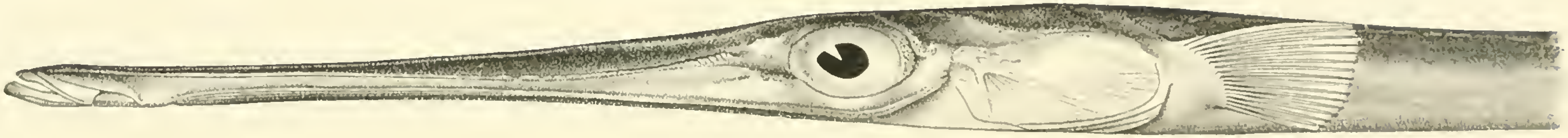
17

EXPLANATION OF PLATE X

	PAGE
Figs. 18, 18*a*. *Fistularia corneta* GILBERT & STARKS. Type specimen; Panama.	56



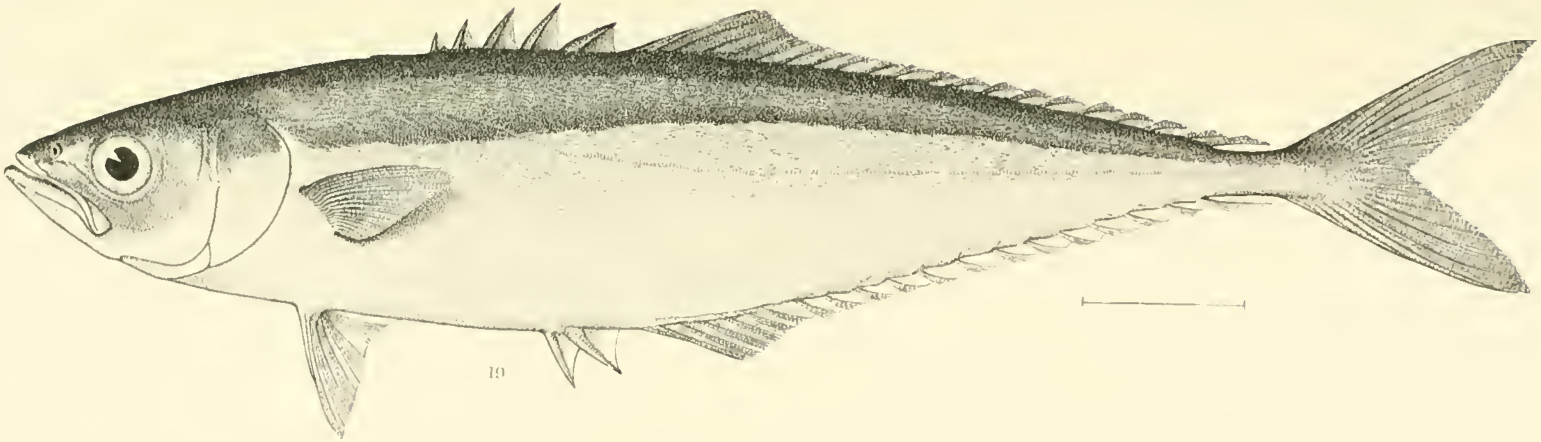
18



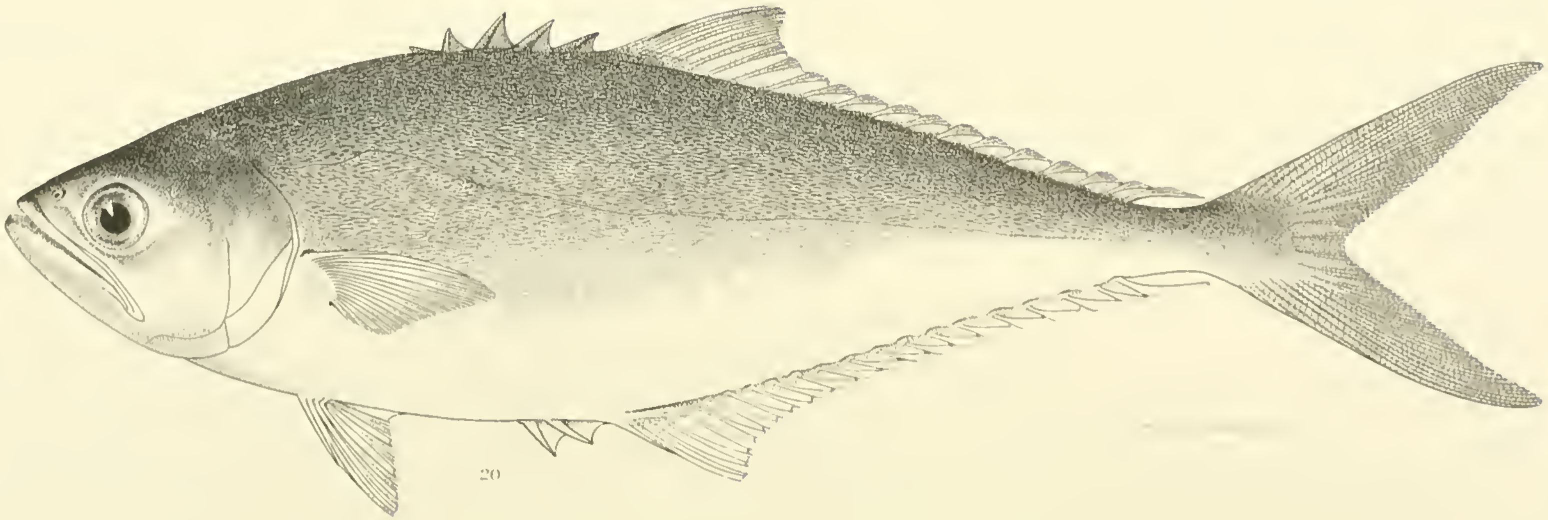
18a

EXPLANATION OF PLATE XI.

		PAGE
Fig. 19.	*Oligoplites refulgens* GILBERT & STARKS. Type specimen; Panama.	73
Fig. 20.	*Oligoplites altus* GÜNTHER. Panama.	72



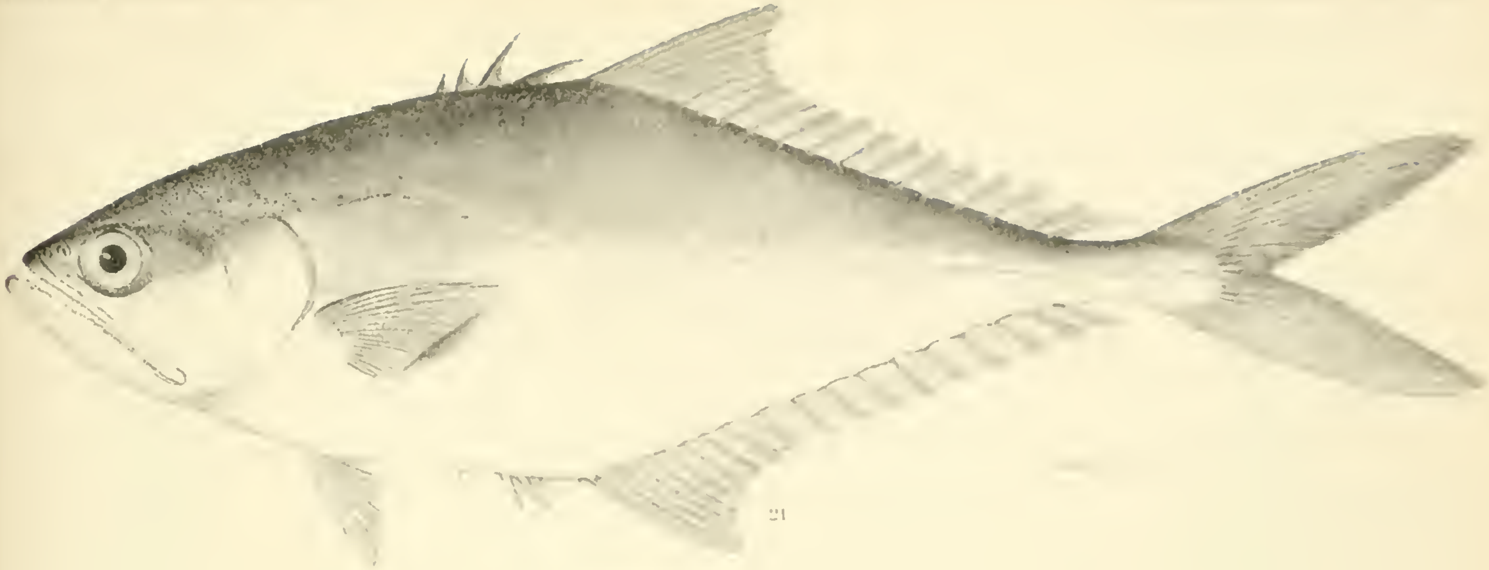
19



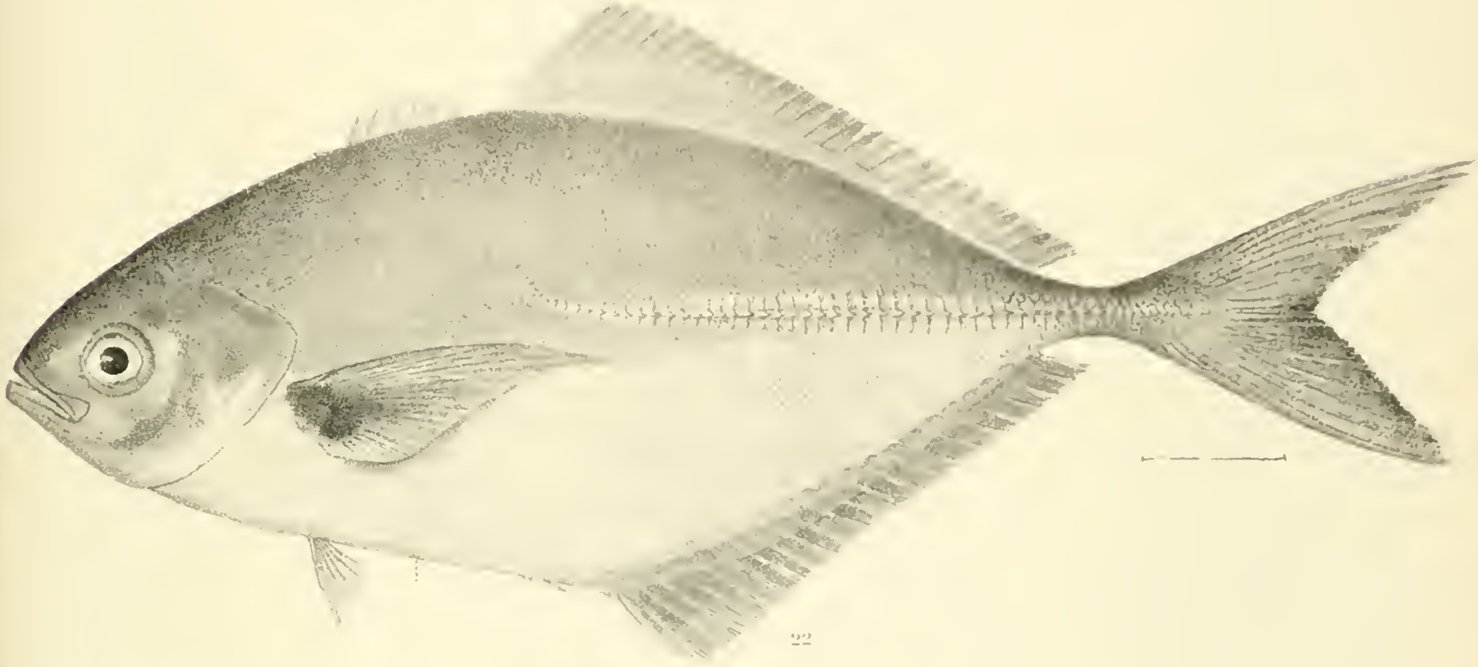
20

EXPLANATION OF PLATE XII.

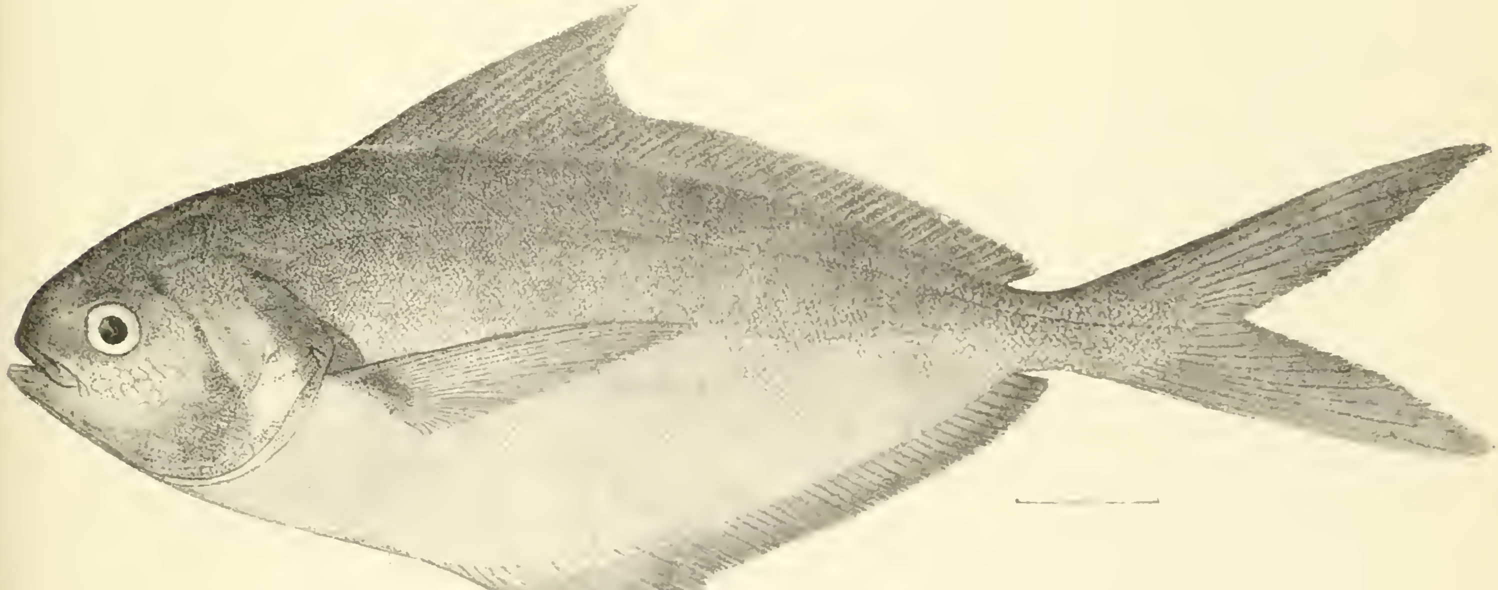
		PAGE
Fig. 21.	*Oligoplites mundus* Jordan & Starks. Panama.	74
Fig. 22.	*Hemicaranx zelotes* Gilbert. Type specimen; Panama.	76
Fig. 23.	*Peprilus snyderi* Gilbert & Starks. Type specimen; Panama.	87



21



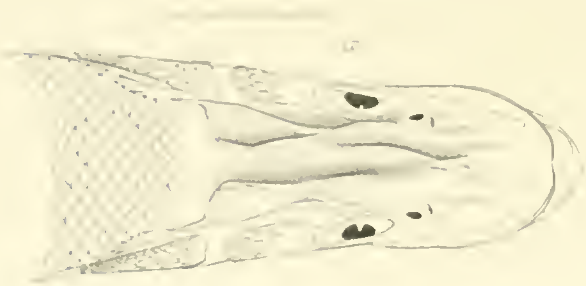
22

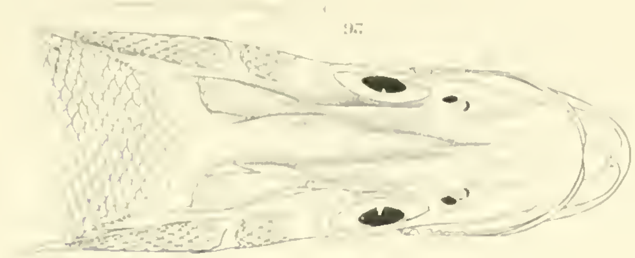


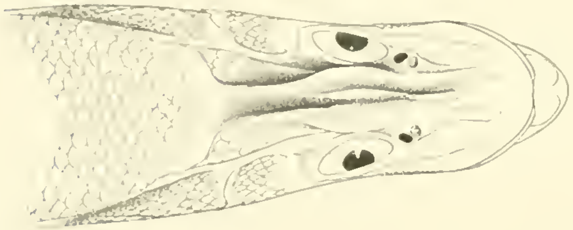
23

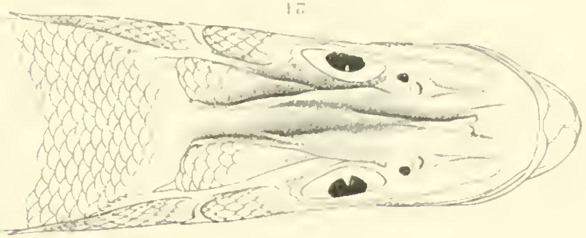
EXPLANATION OF PLATE XIII.

		PAGE
Fig. 24.	*Centropomus ensiferus* POEY. Havana.	92
Fig. 25.	*Centropomus robalito* JORDAN & GILBERT. Panama.	94
Fig. 26.	*Centropomus armatus* GILL. Panama.	92
Fig. 27.	*Centropomus unionensis* BOCOURT. Panama.	90







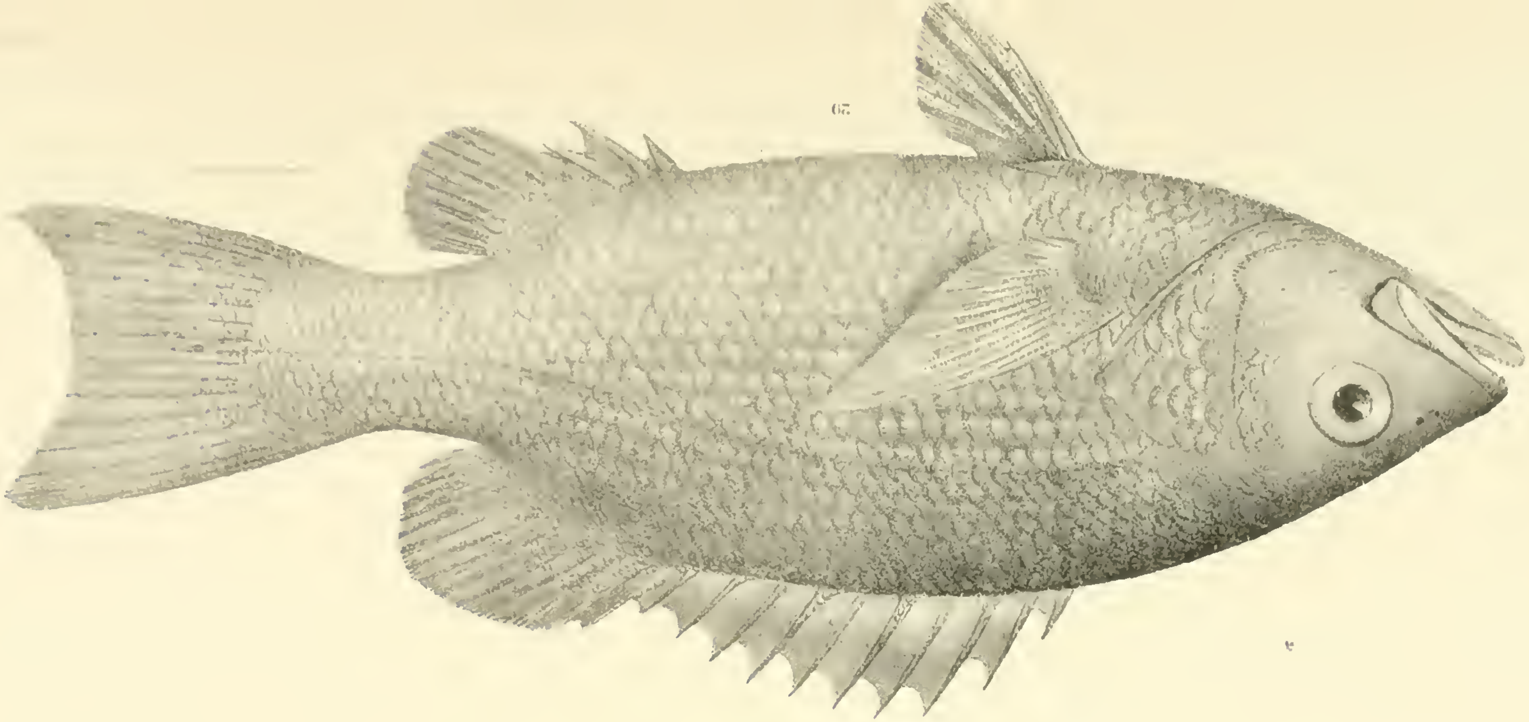


15

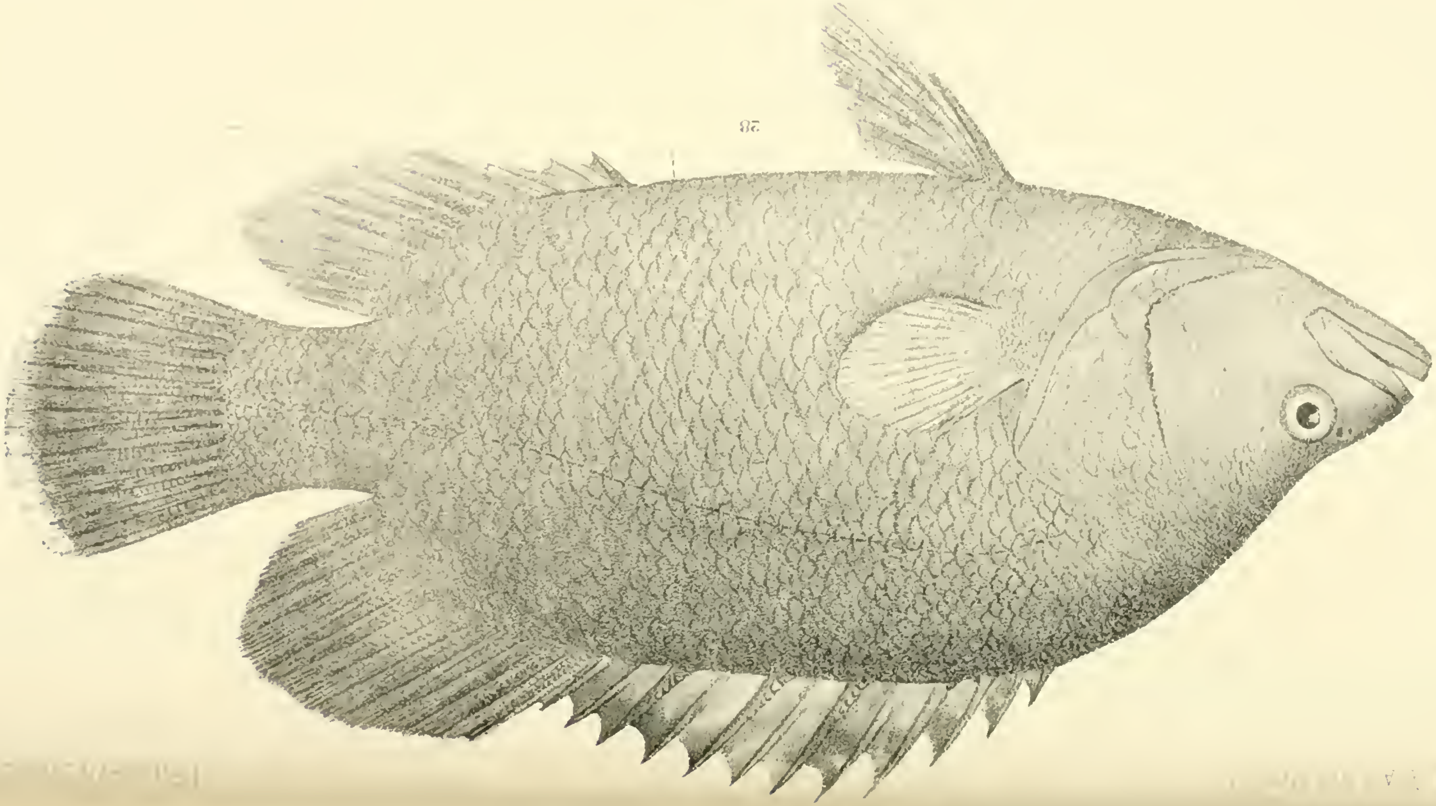
EXPLANATION OF PLATE XIV.

	PAGE
Fig. 28. *Lobotes pacificus* Gilbert. Type specimen; Panama.	100
Fig. 29. *Lutianus jordani* Gilbert. Type specimen; Panama.	102

29

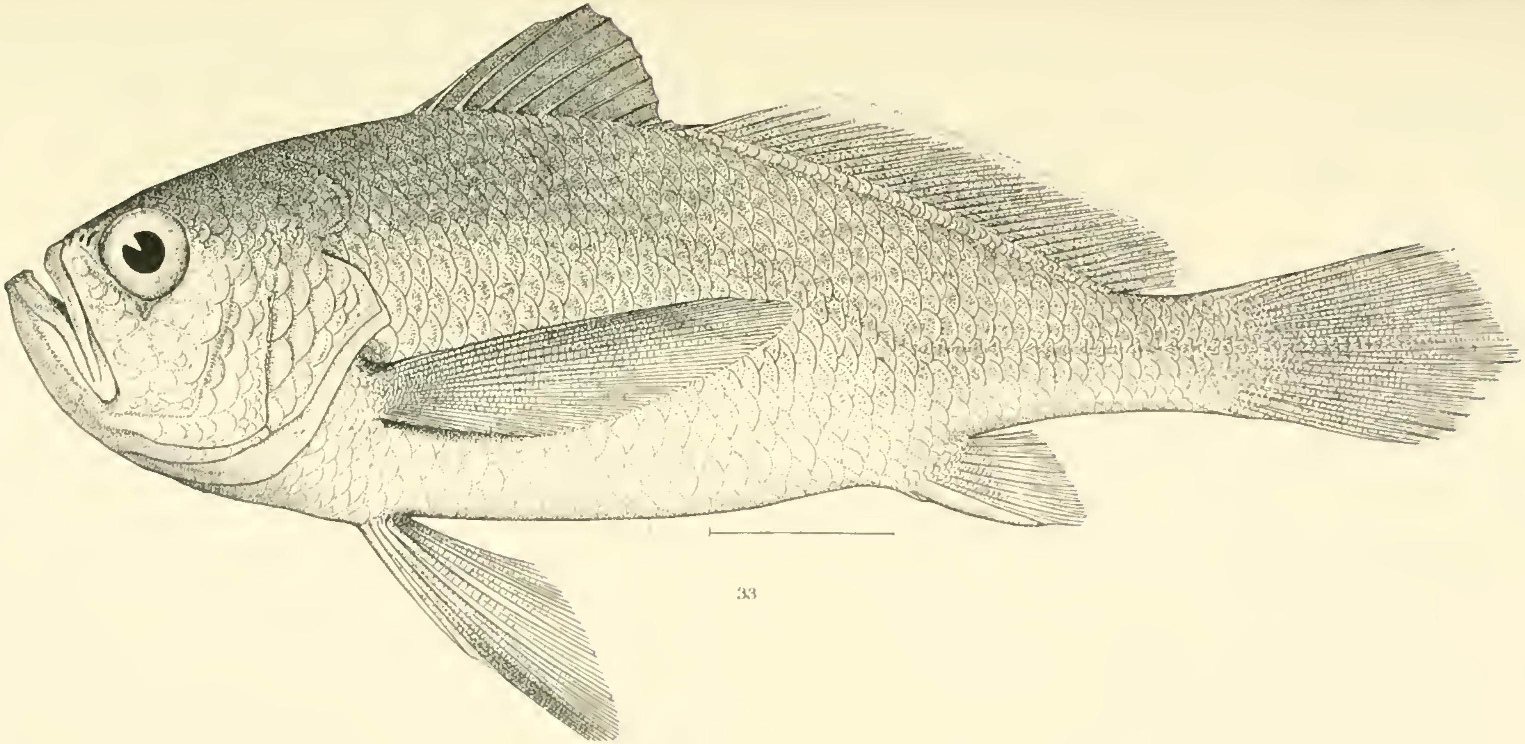


28

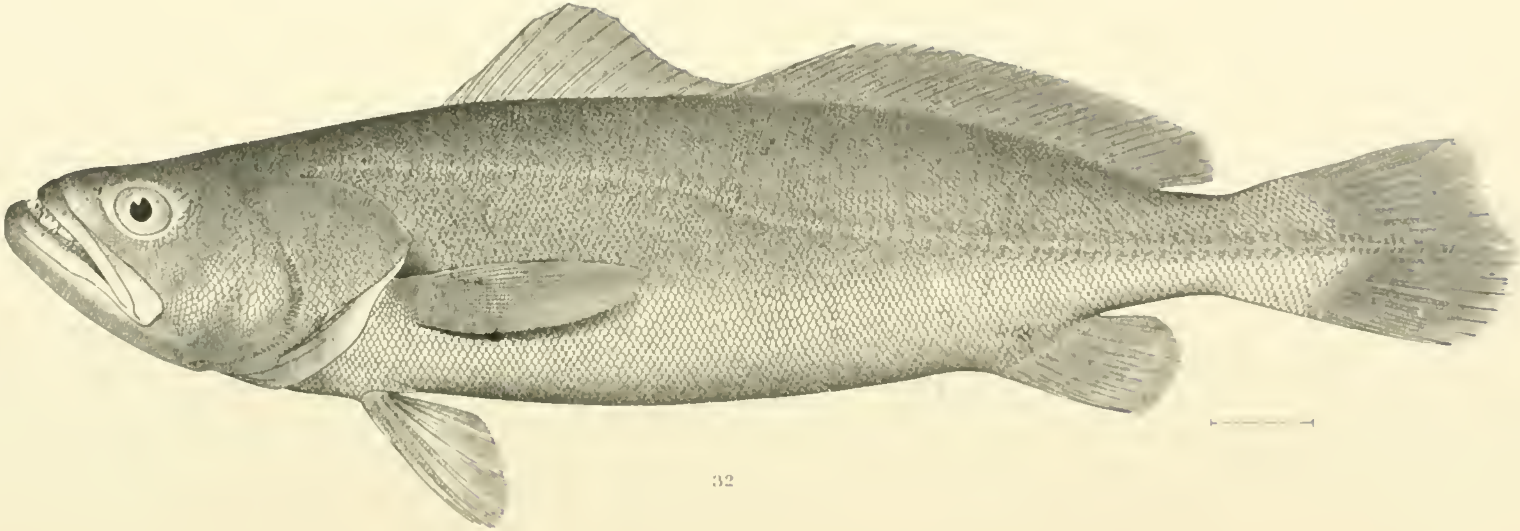


EXPLANATION OF PLATE XVI.

	PAGE
Fig. 32. *Sagenichthys mordax* Gilbert & Starks. Type specimen; Panama.	121
Fig. 33. *Larimus effulgens* Gilbert. Type specimen; Panama.	123



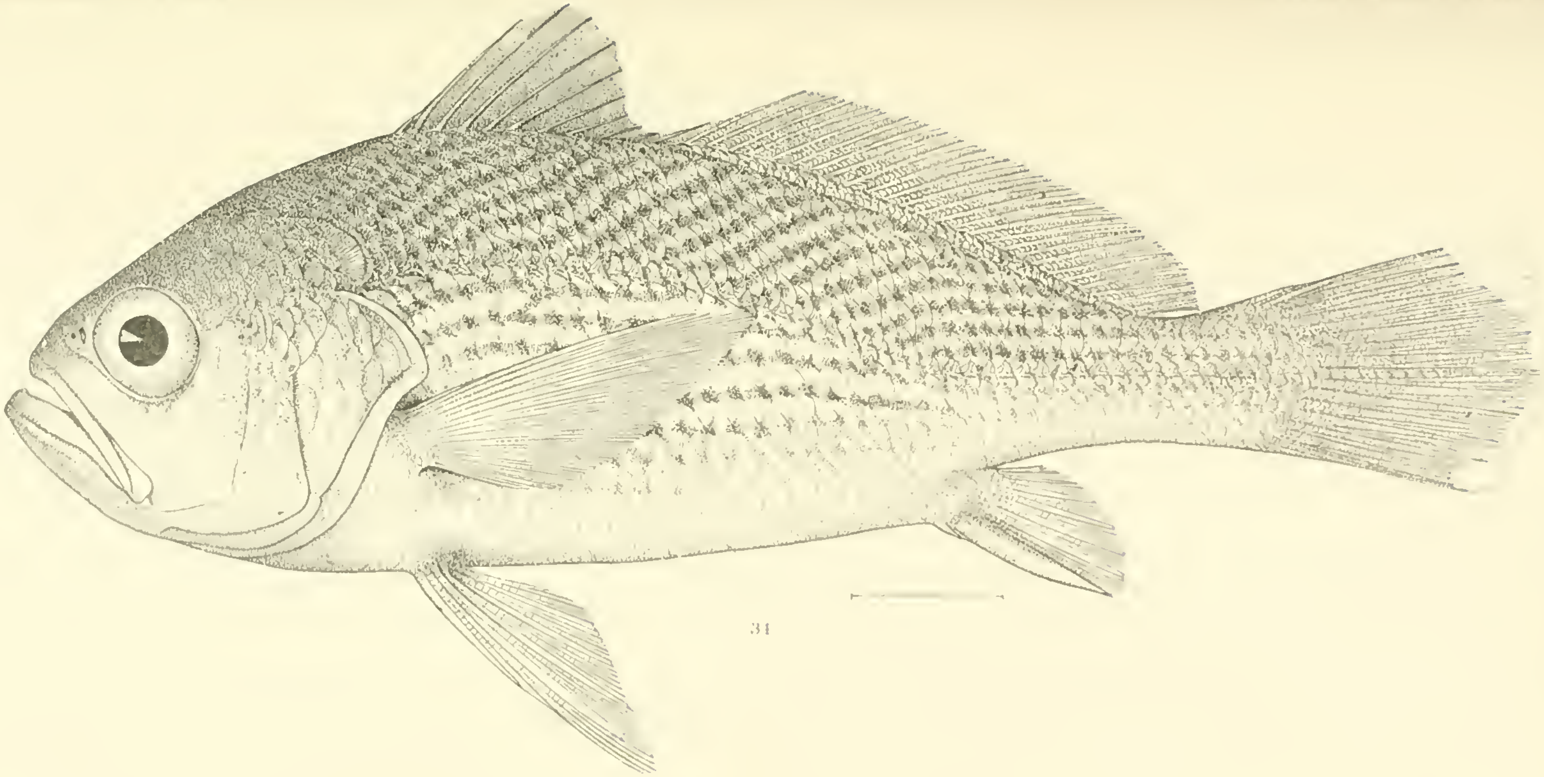
33



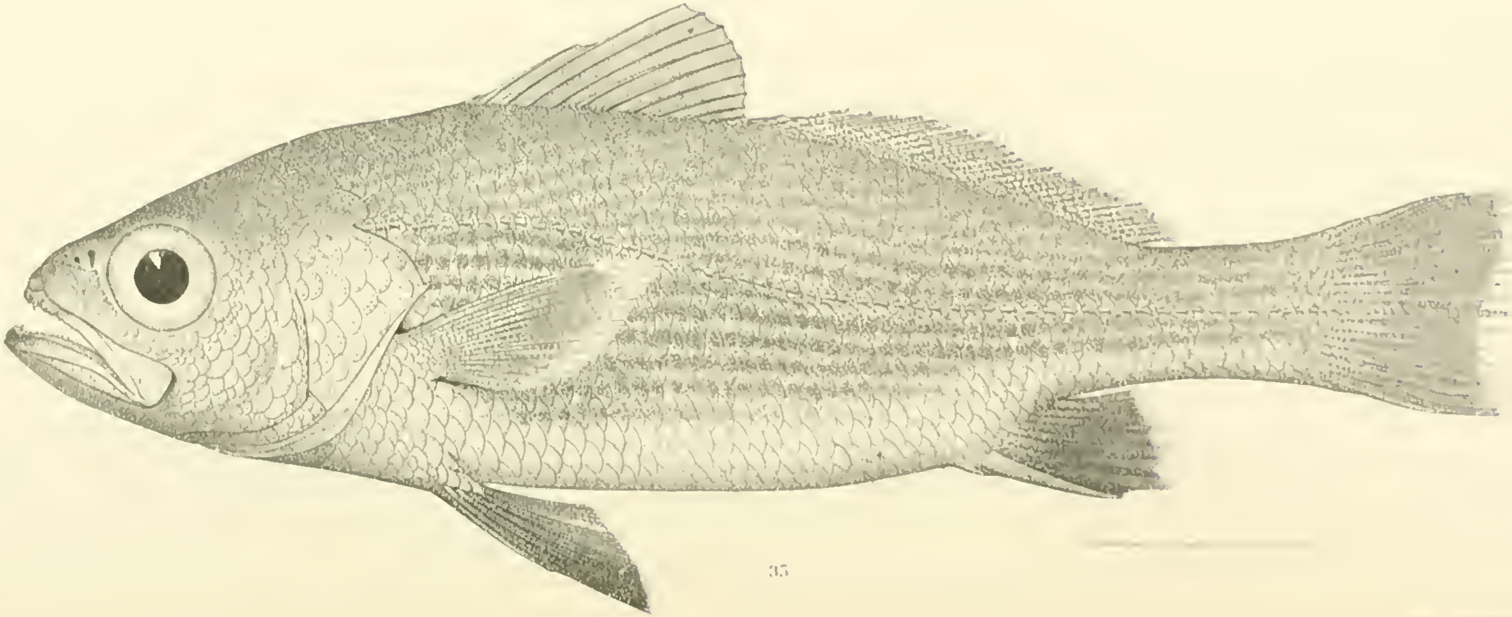
32

EXPLANATION OF PLATE XVII.

		PAGE
Fig. 34.	*Larimus acclivis* JORDAN & BRISTOL. Panama.	124
Fig. 35.	*Odontoscion xanthops* GILBERT. Type specimen; Panama.	124



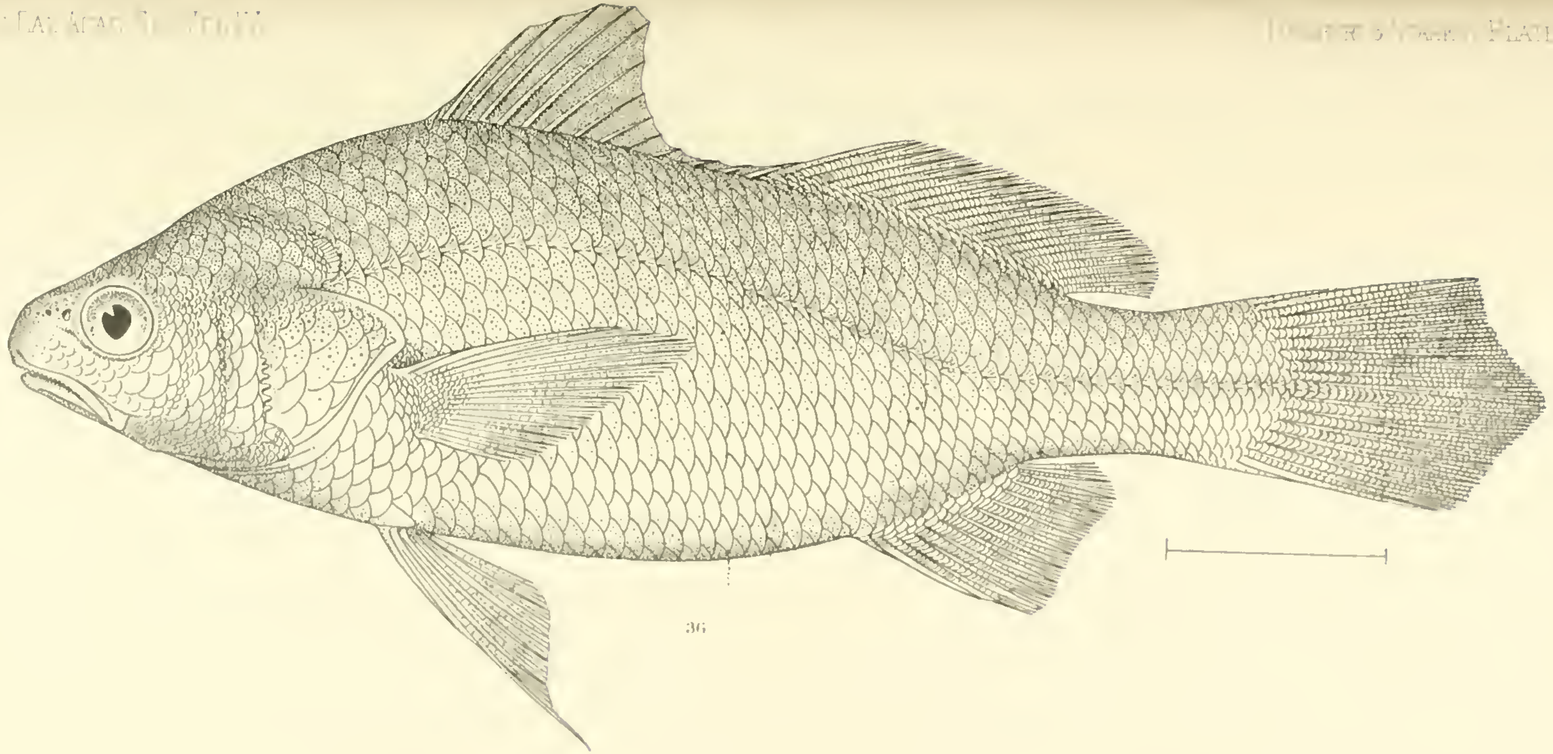
31

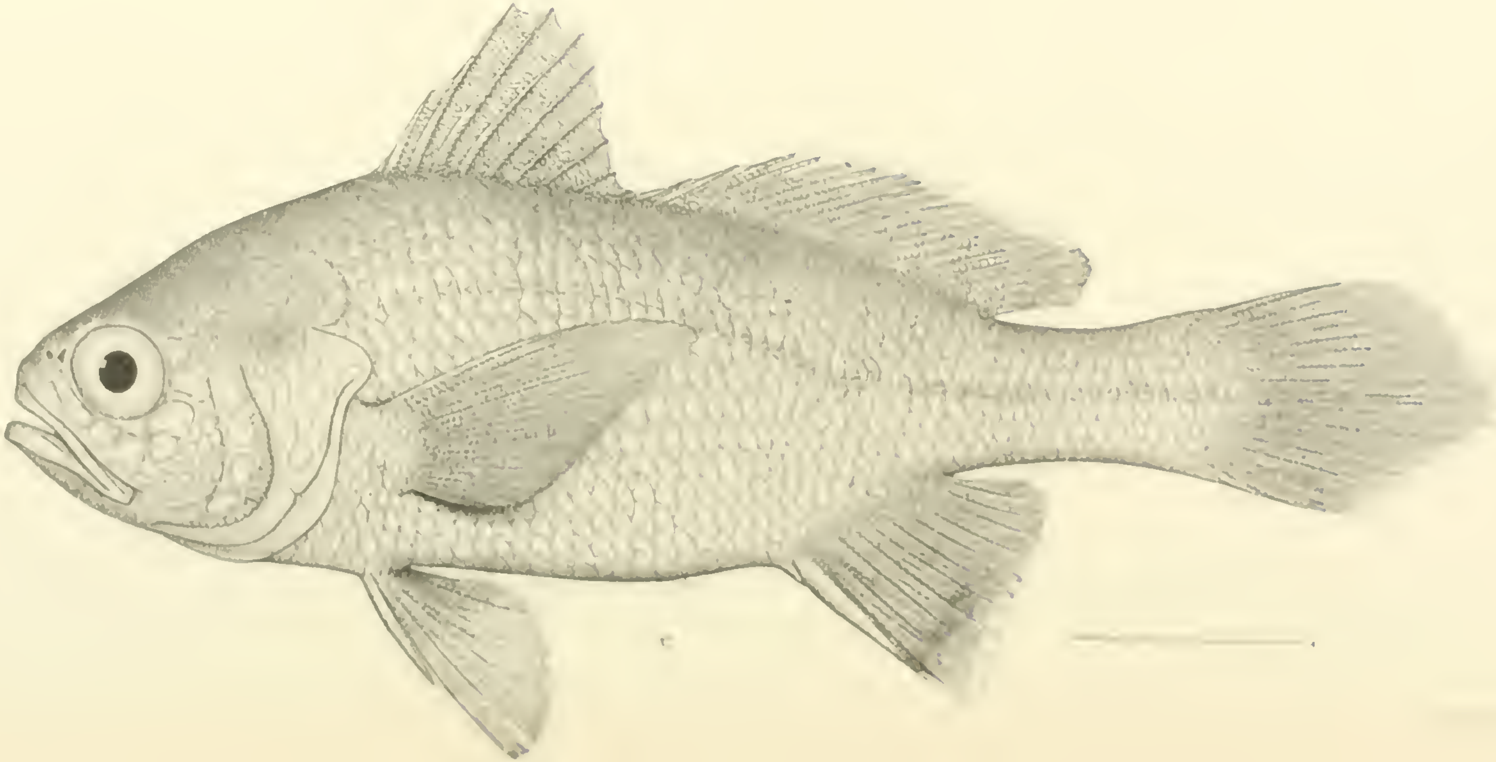


35

EXPLANATION OF PLATE XVIII.

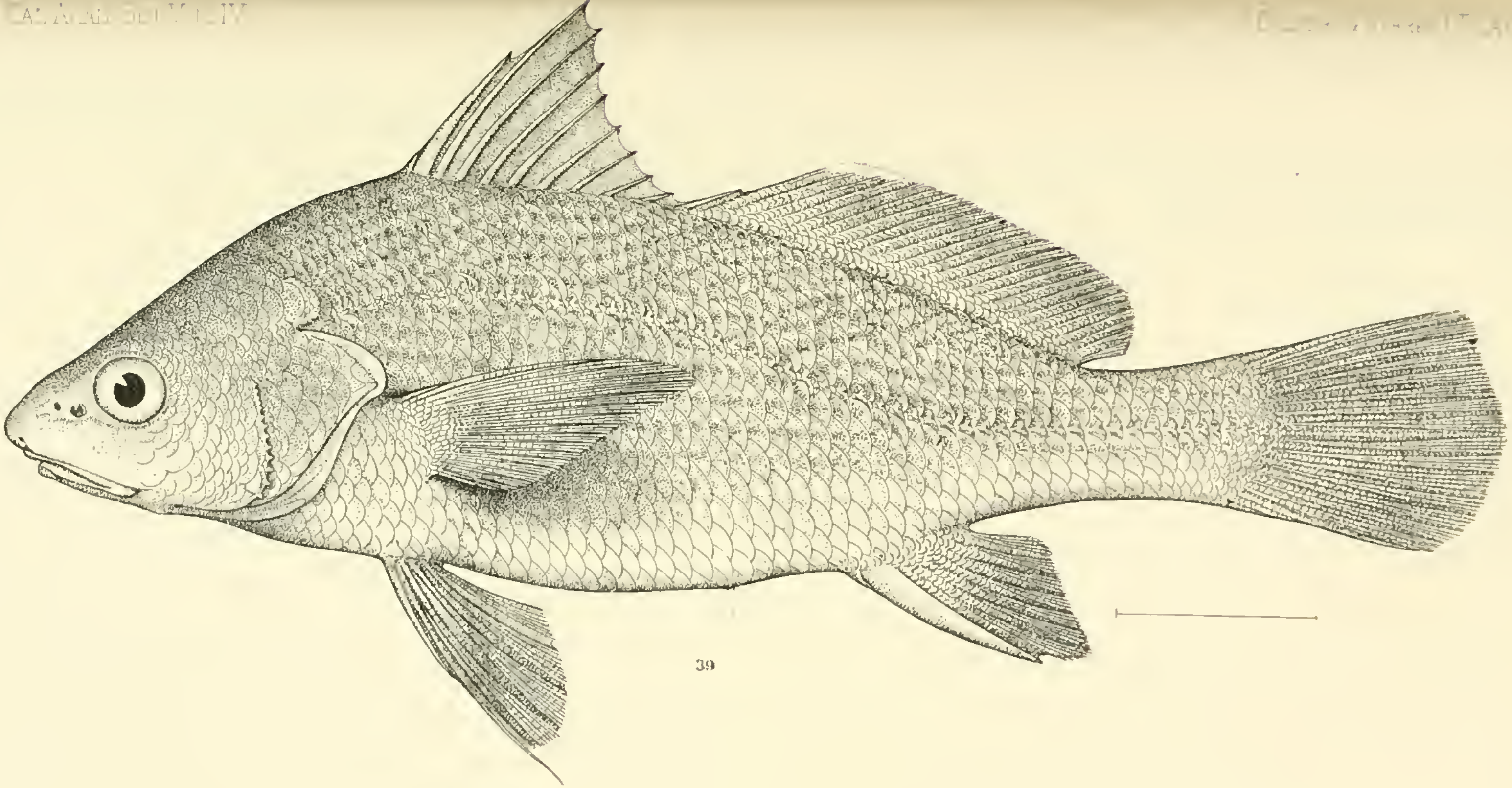
	PAGE
Fig. 36. *Stellifer illecebrosus* GILBERT. Type specimen; Panama.	128
Fig. 37. *Stellifer zestocarus* GILBERT. Type specimen; Panama.	129


36

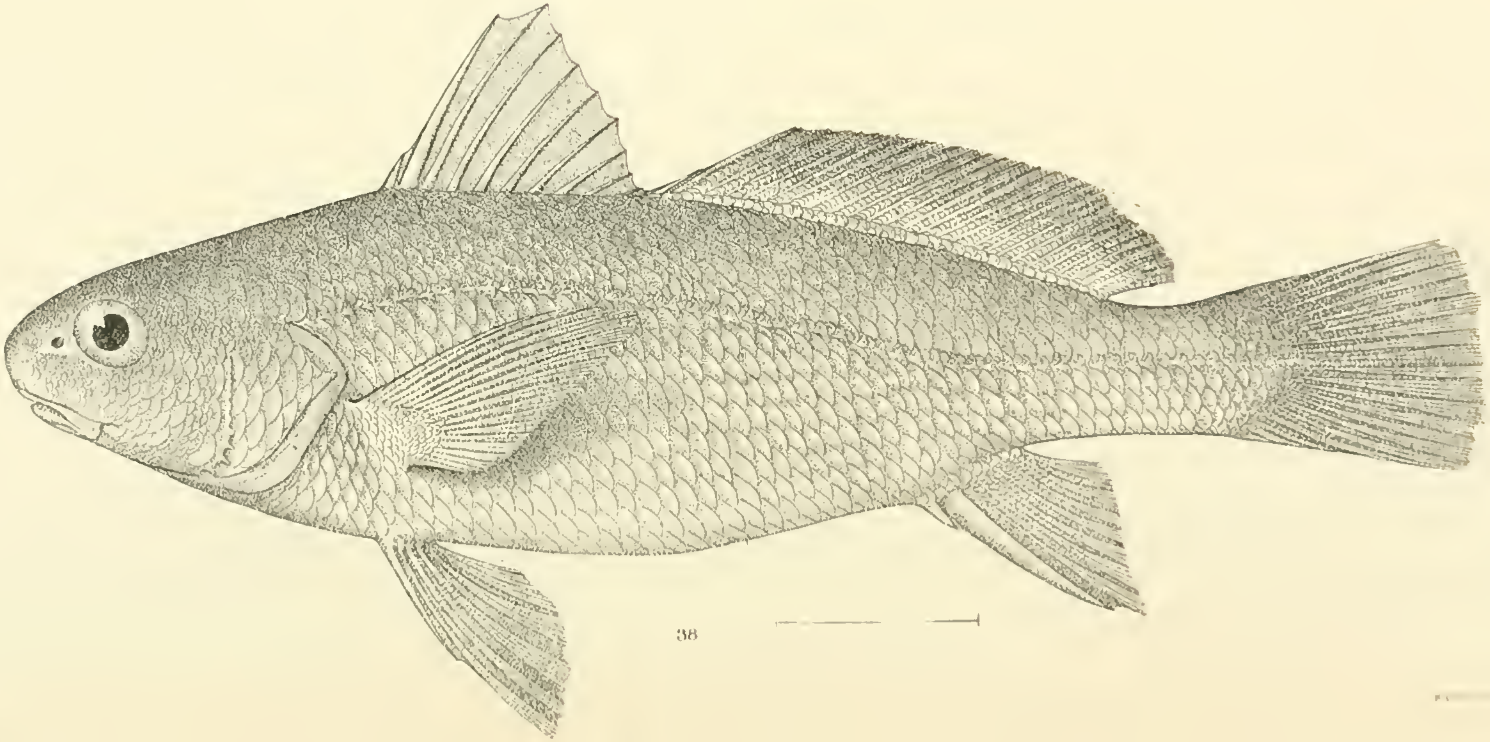


EXPLANATION OF PLATE XIX.

	PAGE
Fig. 19. *Ophioscion simulus* Gilbert. Type specimen; Panama.	130
Fig. 20. *Ophioscion scierus* Jordan & Gilbert. Panama.	131



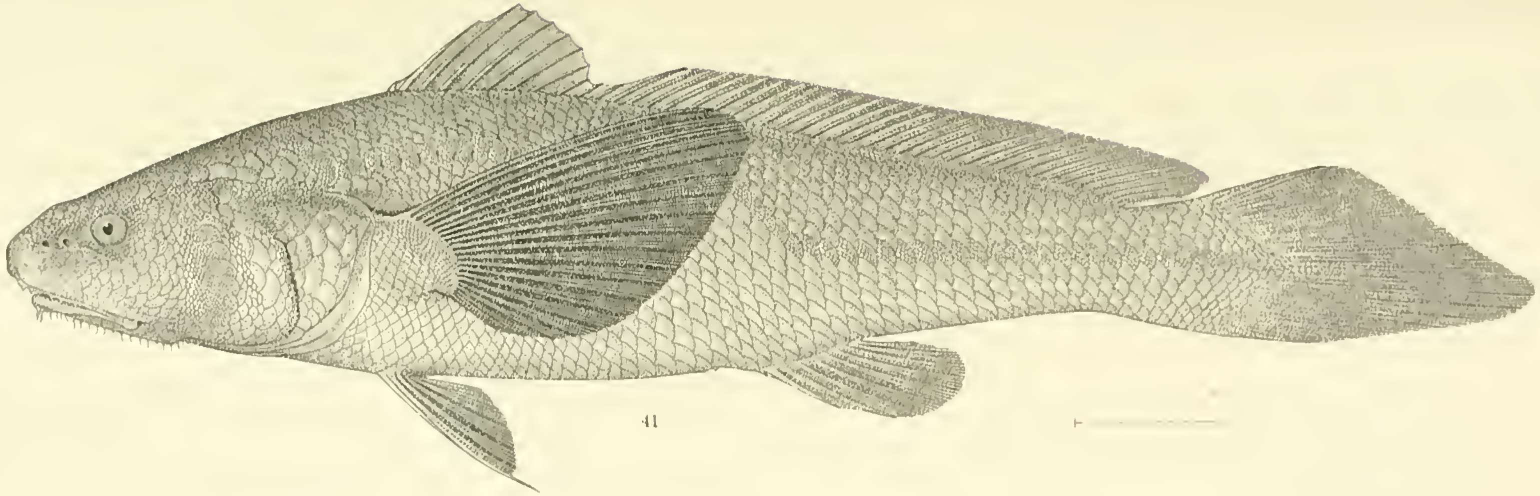
39



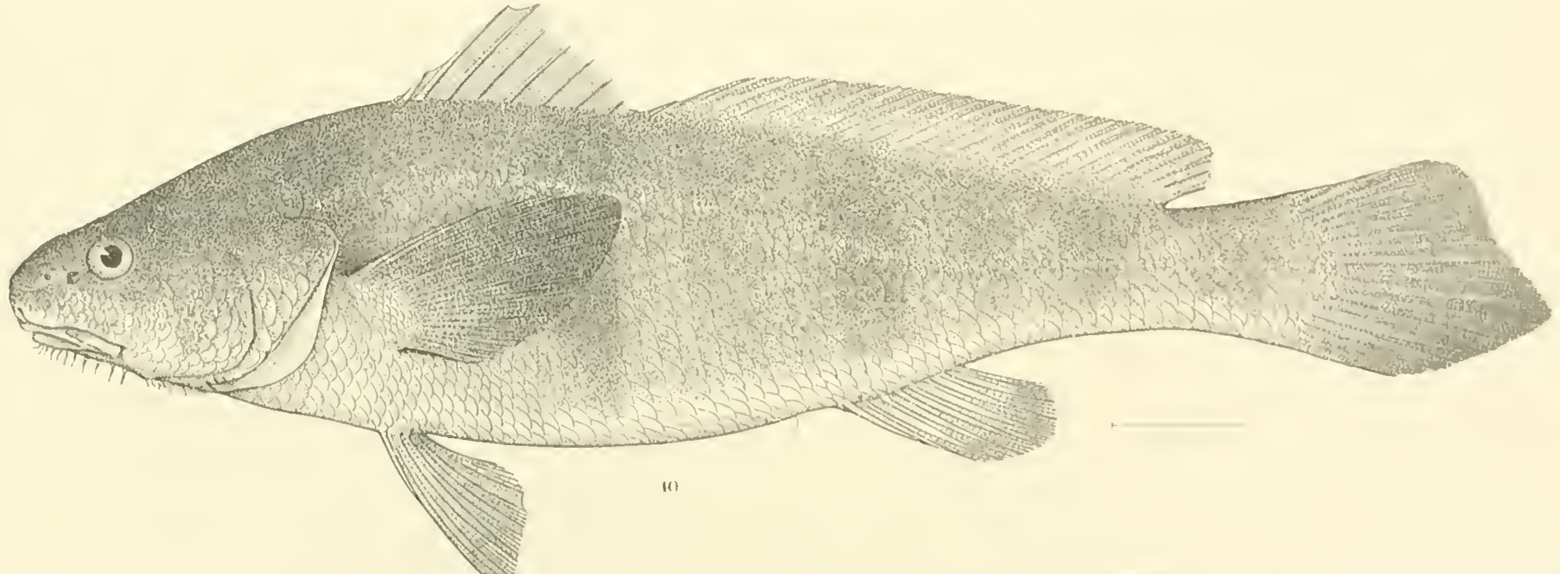
38

EXPLANATION OF PLATE XX.

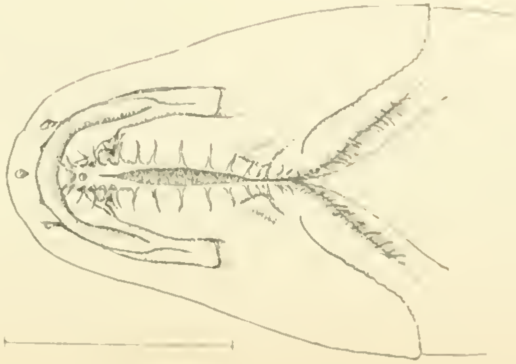
		PAGE
Figs. 40, 40*a*.	*Polyclemus goodei* GILBERT. Type specimen; Panama.	135
Fig. 41.	*Paralonchurus petersi* BOCOURT. Panama.	136



41



40

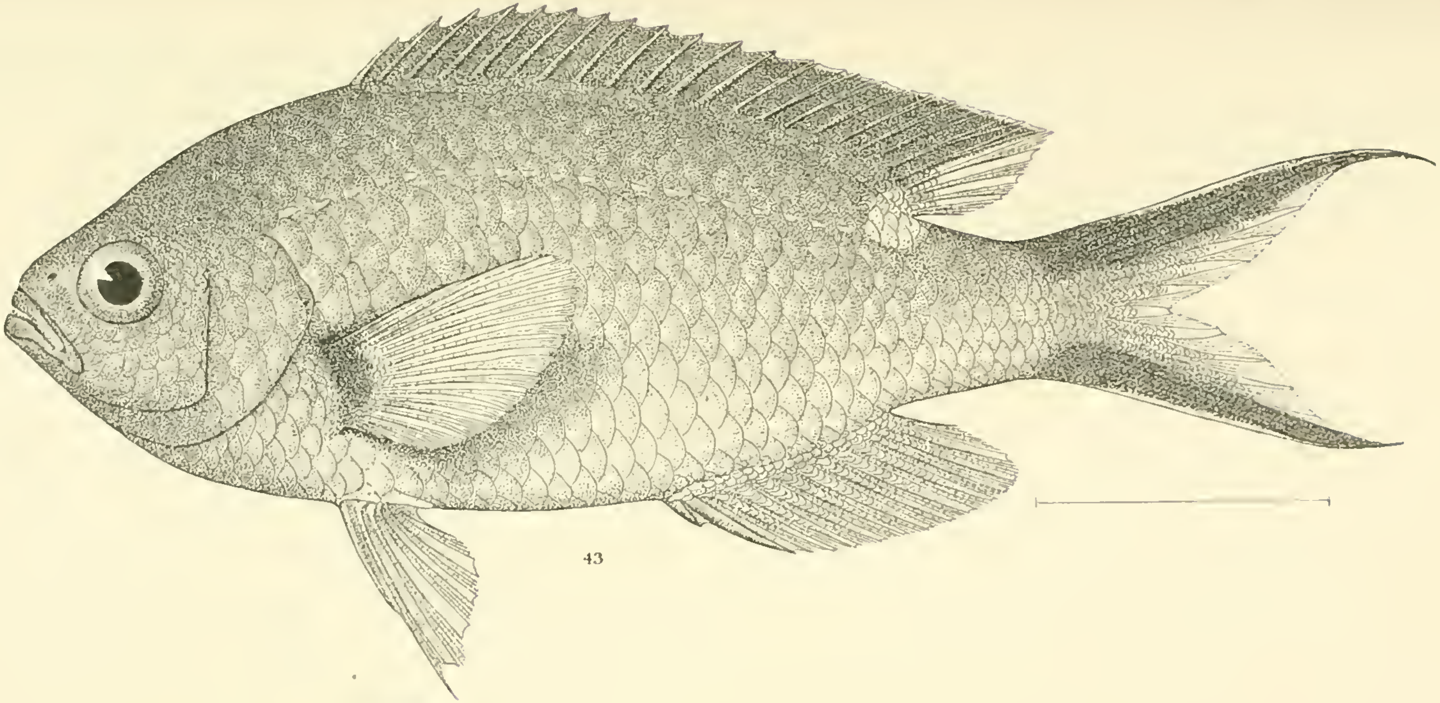


40 a

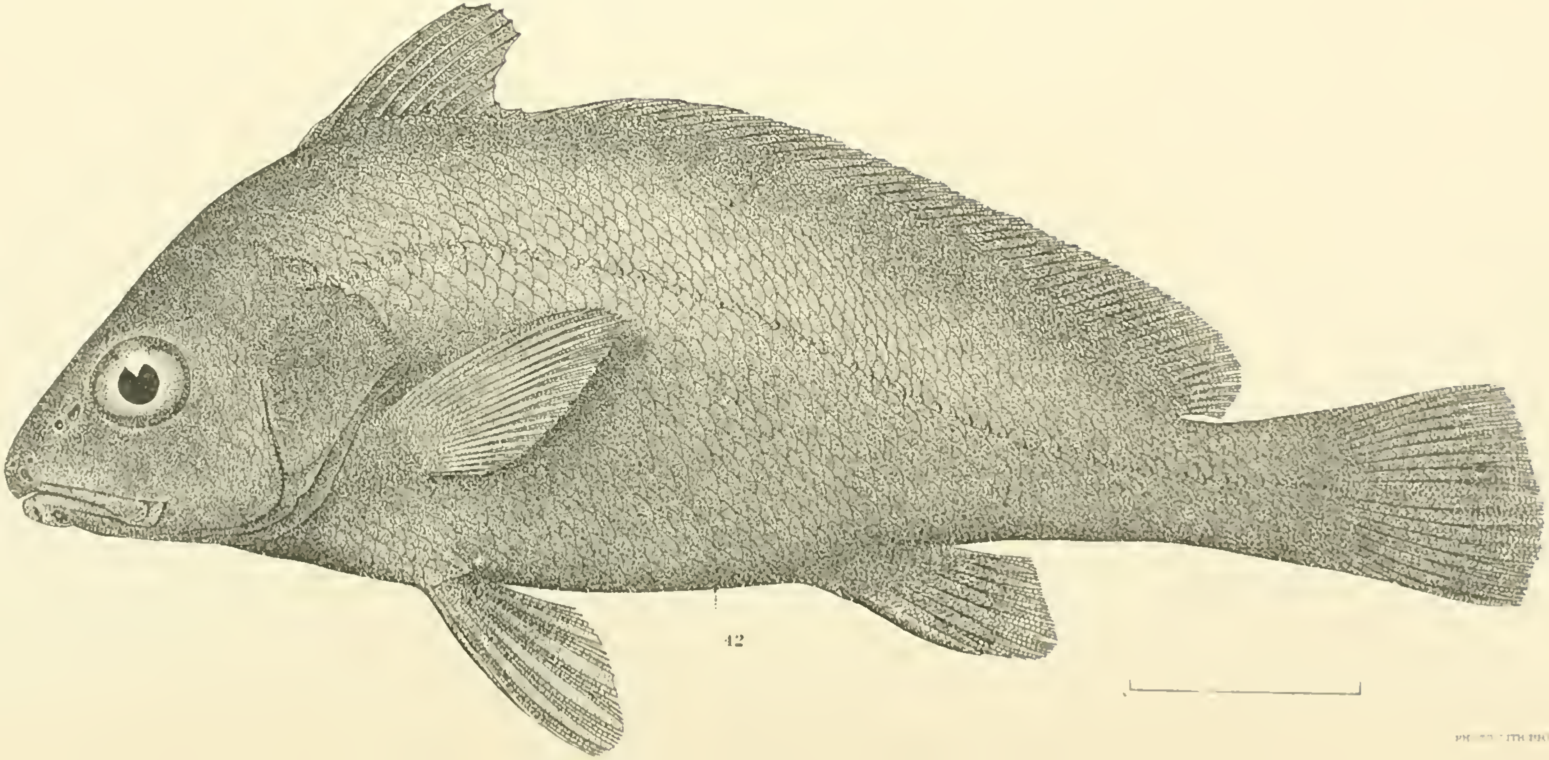
LITH BRITTON & [illegible]

EXPLANATION OF PLATE XXI.

	PAGE
Fig. 42. *Eques viola* GILBERT. Type specimen; Panama.	138
Fig. 43. *Chromis atrilobatus* GILL. Panama.	139



43

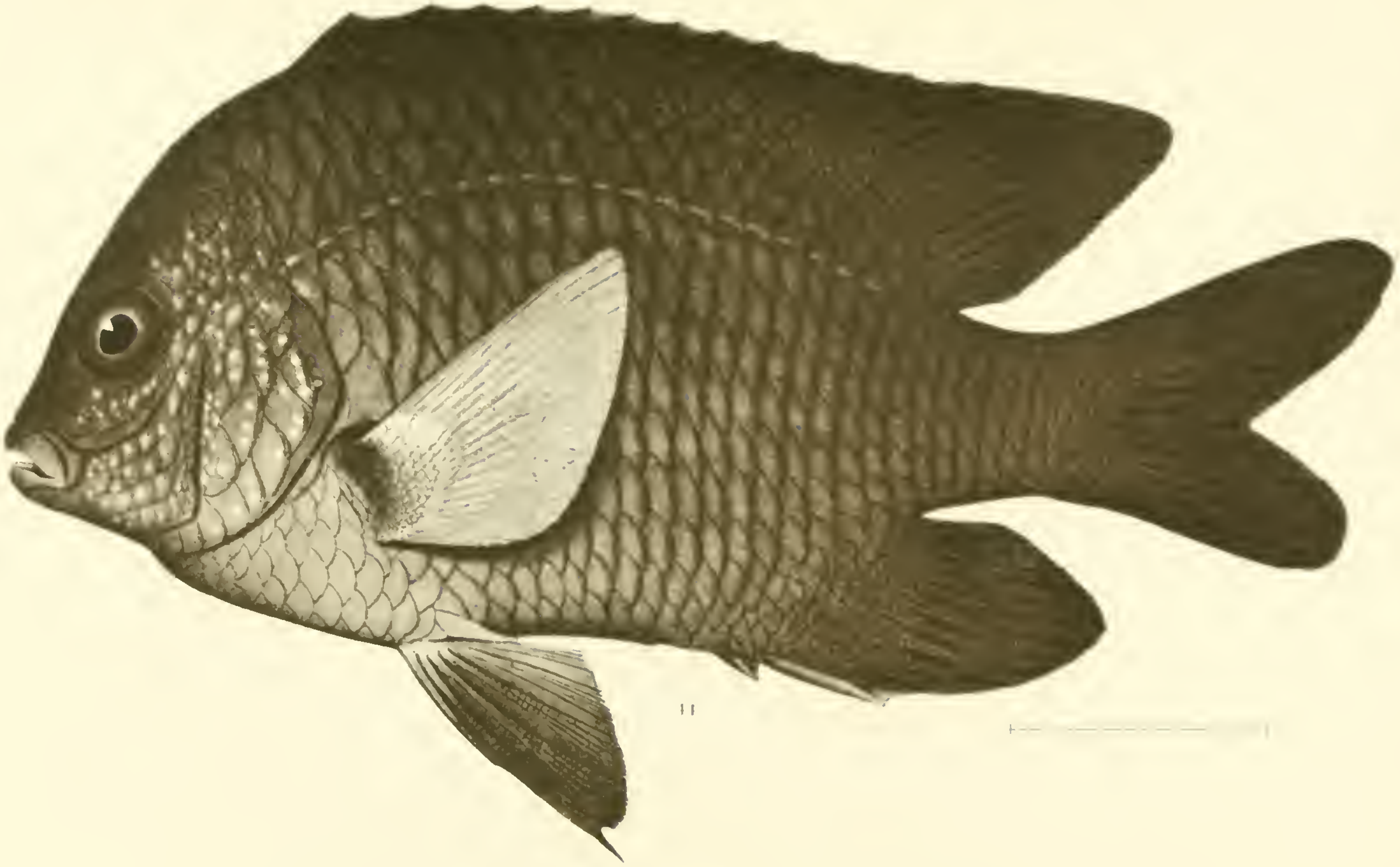


42

PHOTO-LITH BRITTON & REY

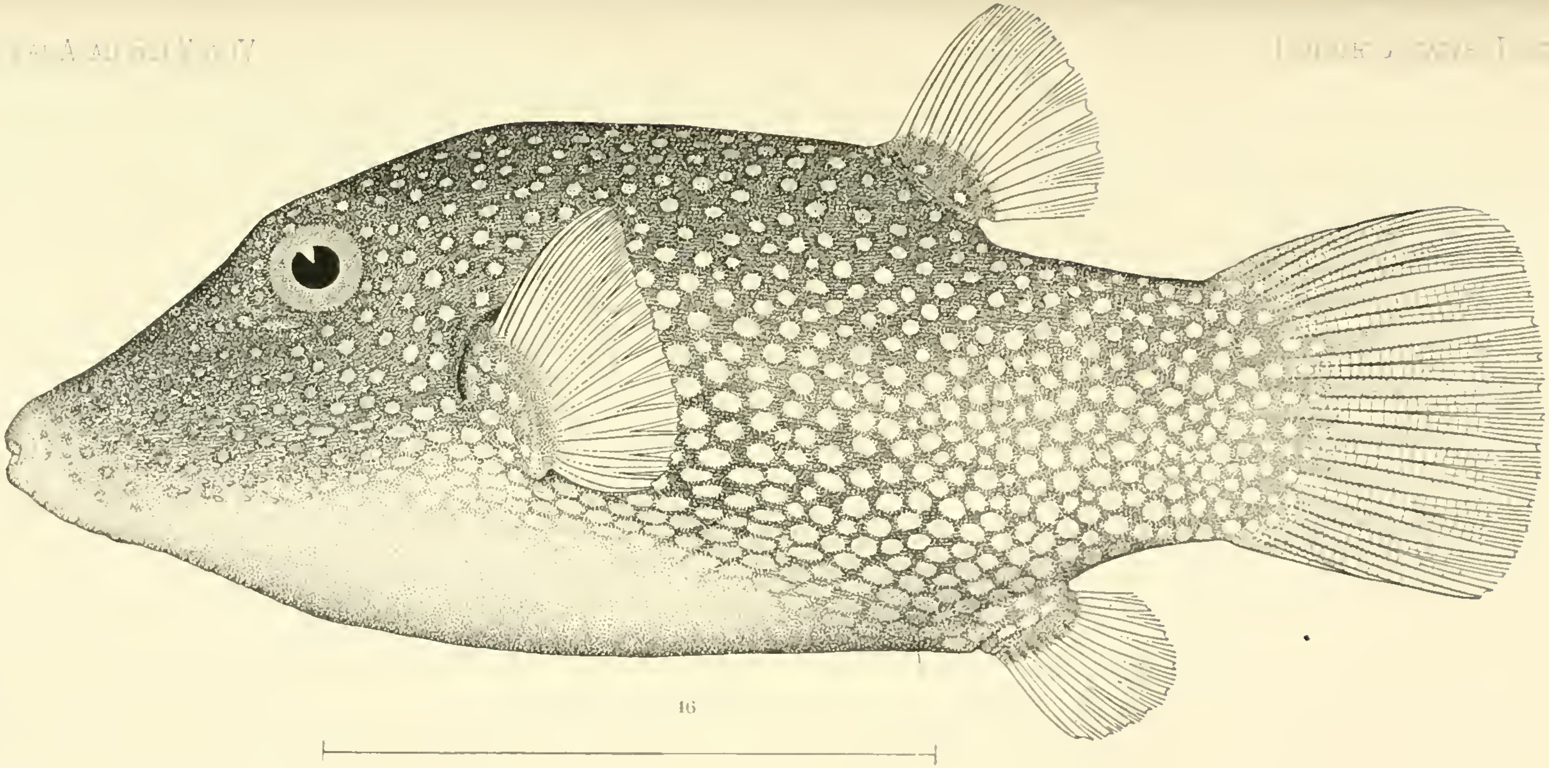
EXPLANATION OF PLATE XXII.

	PAGE
Fig. 44. *Pomacentrus gilli* GILBERT & STARKS. Type specimen; Panama.	141

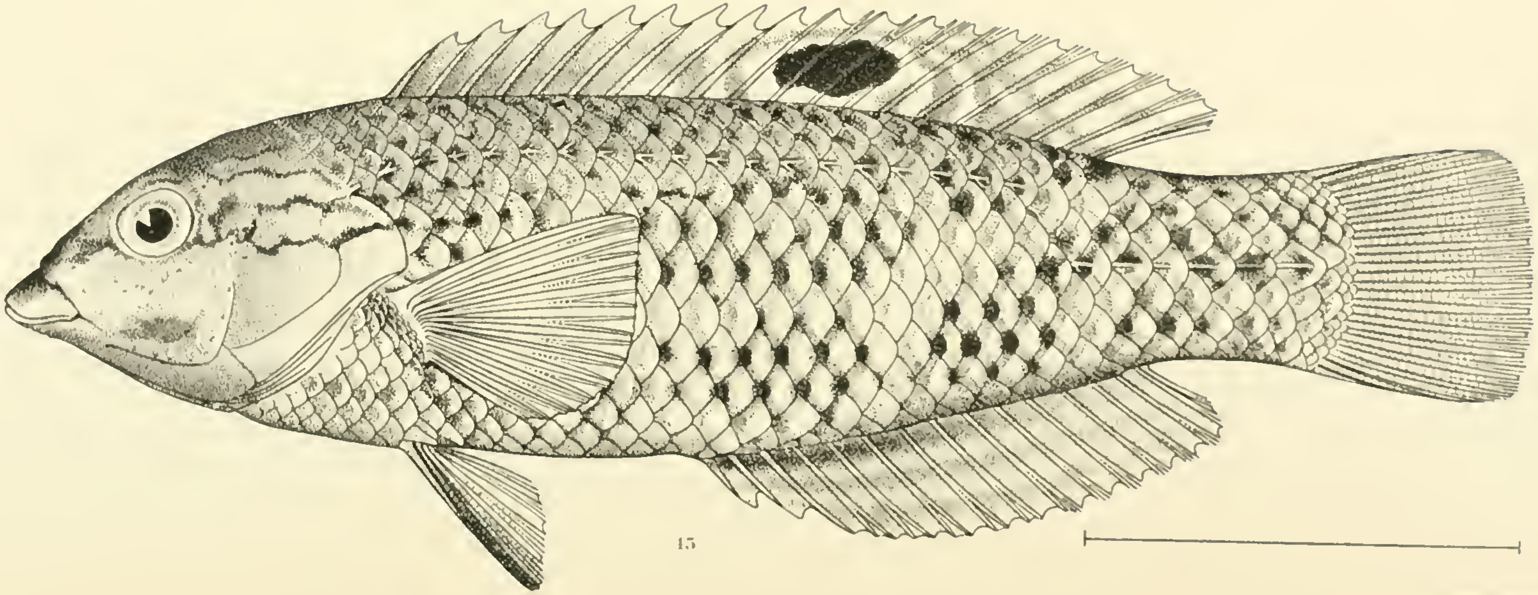


EXPLANATION OF PLATE XXIII.

		PAGE
Fig. 45.	*Iridio* *macgregori* GILBERT & STARKS. Type specimen; Panama.	145
Fig. 46.	*Eumycterias punctatissimus* GUNTHER. Panama.	160



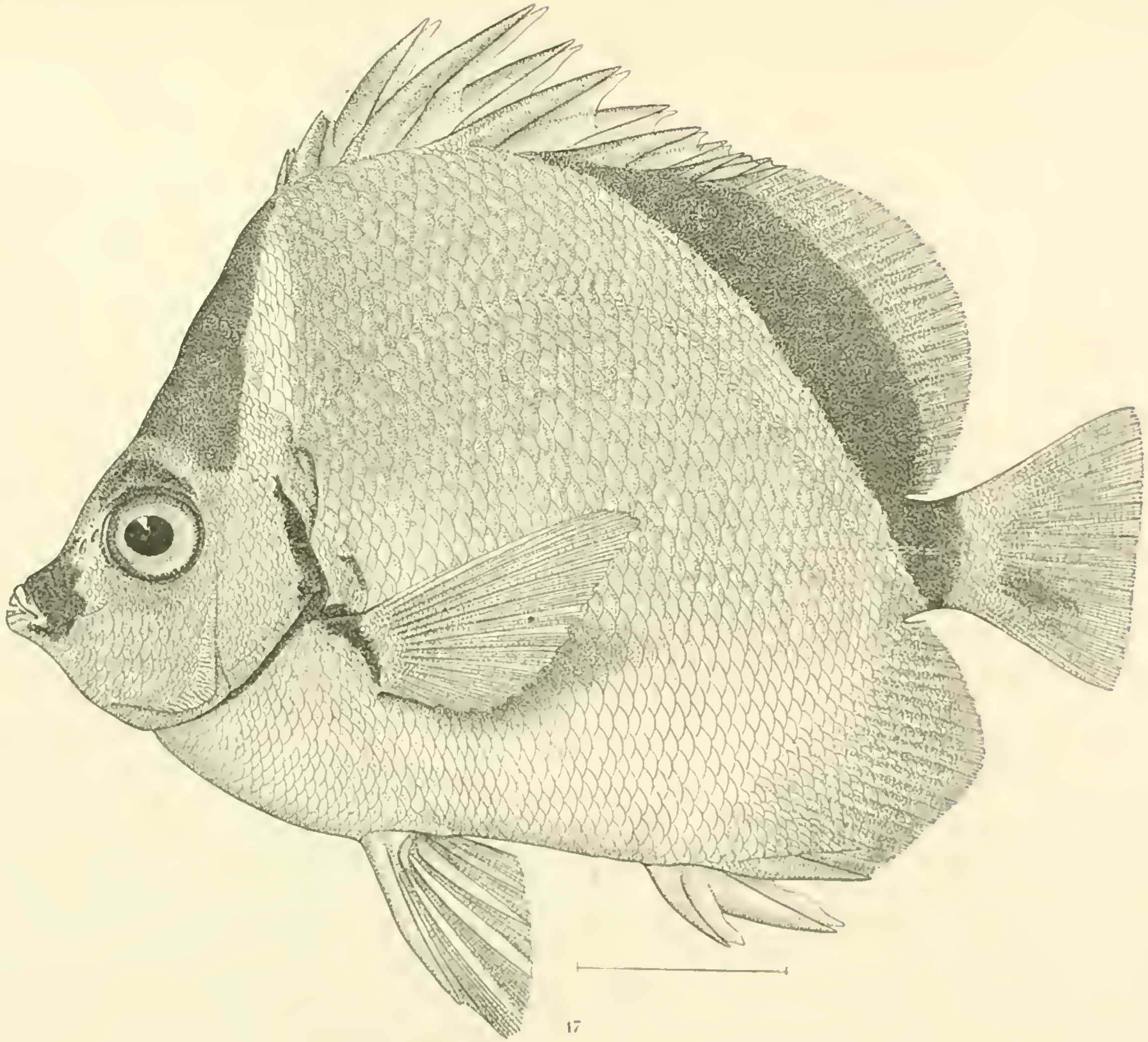
16



15

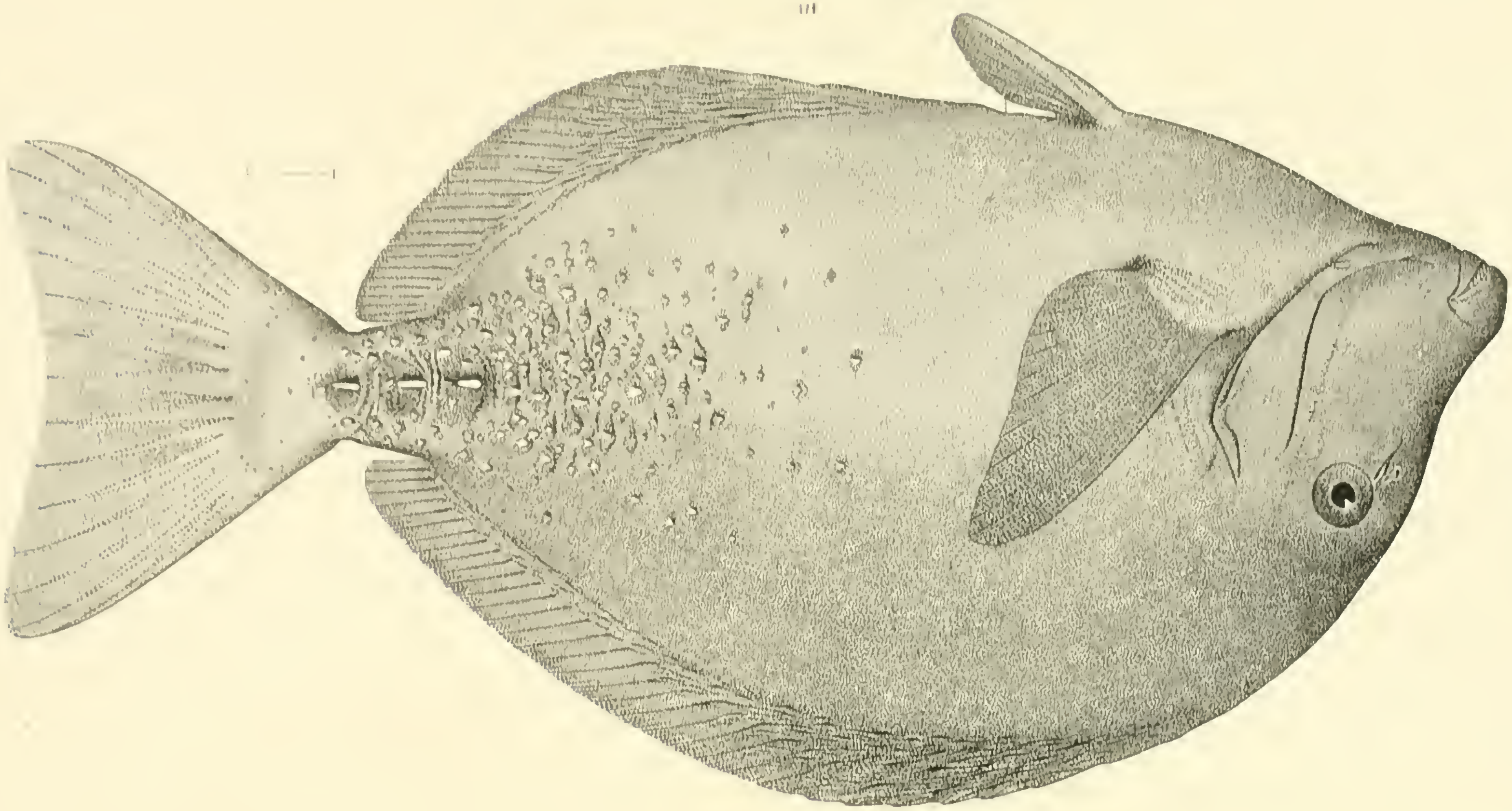
EXPLANATION OF PLATE XXIV

	PAGE
Fig. 47. *Chætodon nigrirostris* GILL. Panama.	148


17

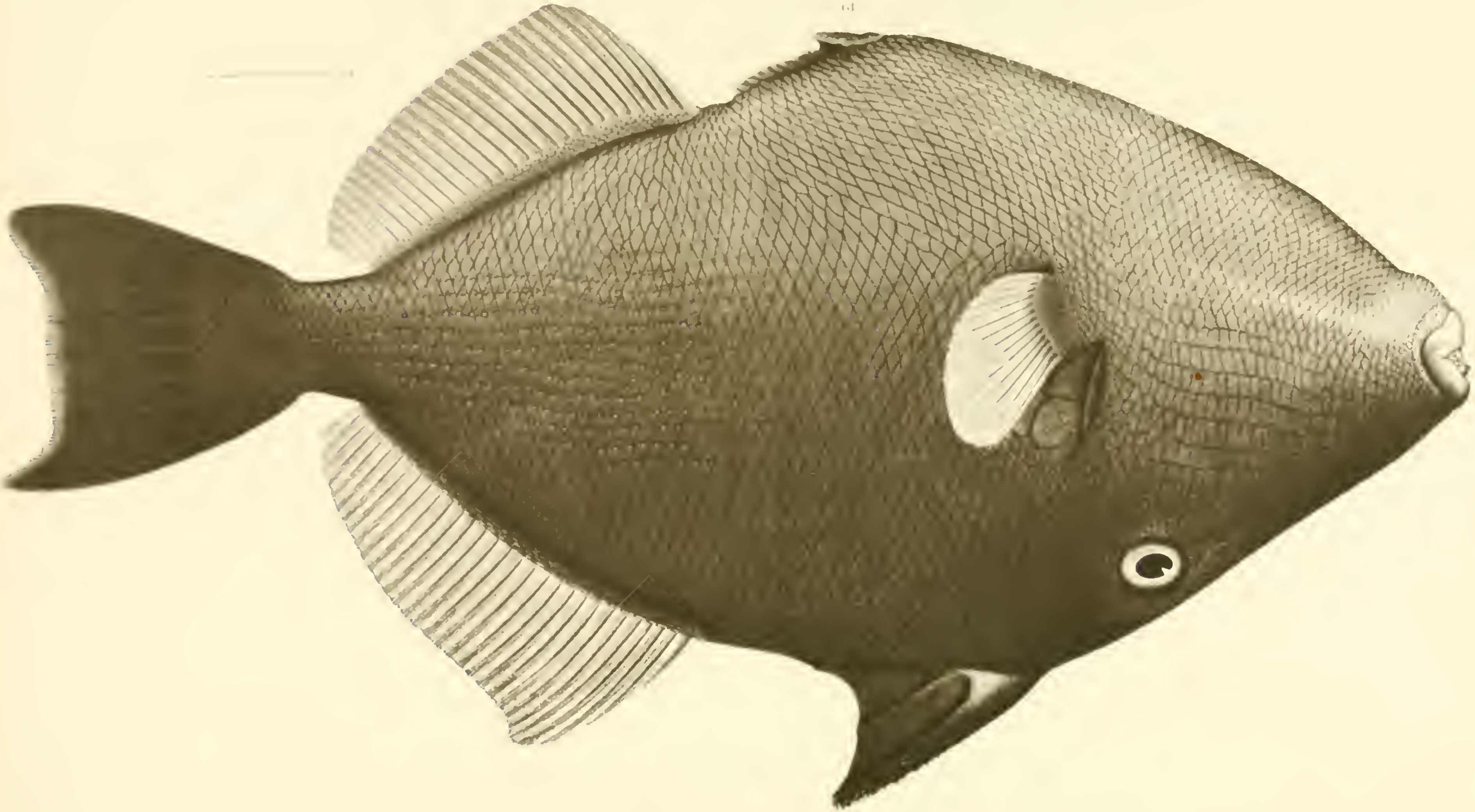
EXPLANATION OF PLATE XXV.

	PAGE
Fig. 1. [illegible] *hopkinsi* GILBERT & STARKS. Type specimen; Panama.	155



EXPLANATION OF PLATE XXVI.

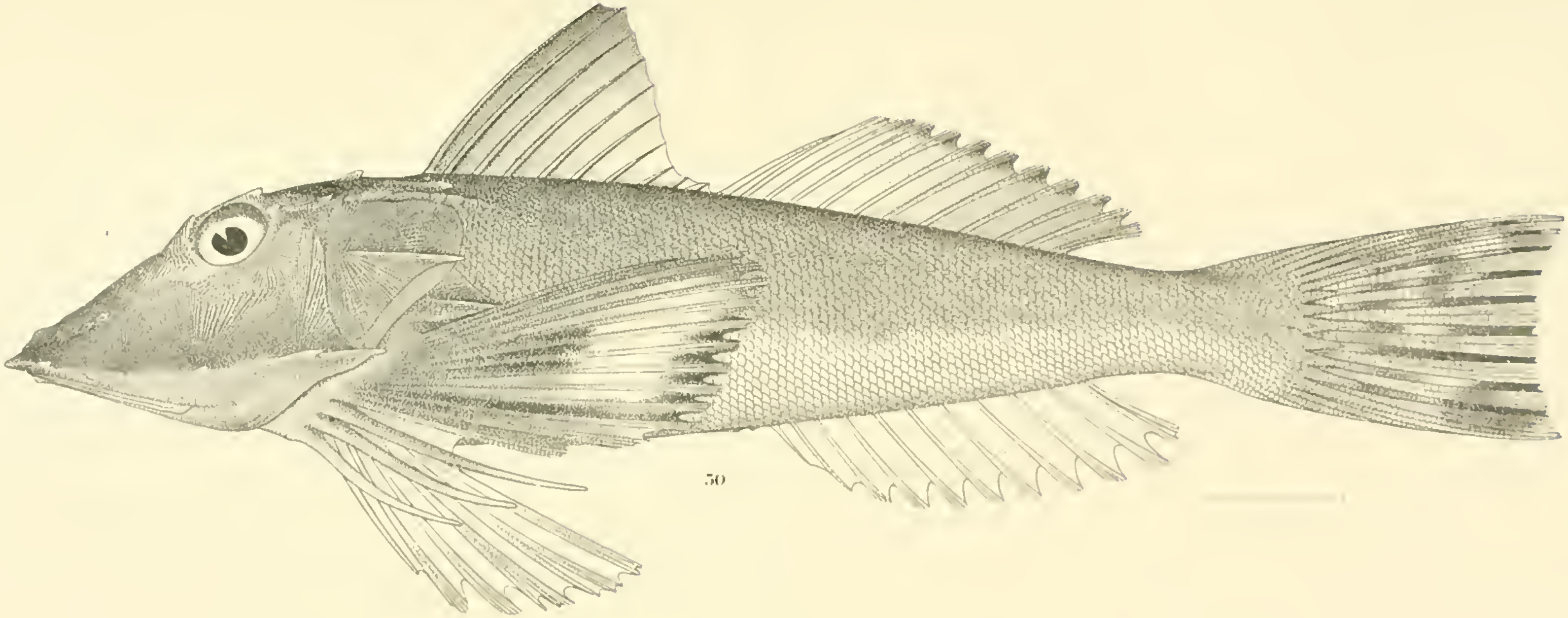
	PAGE
Fig. 49. *Balistes verres* Gilbert & Starks. Type specimen; Panama.	153



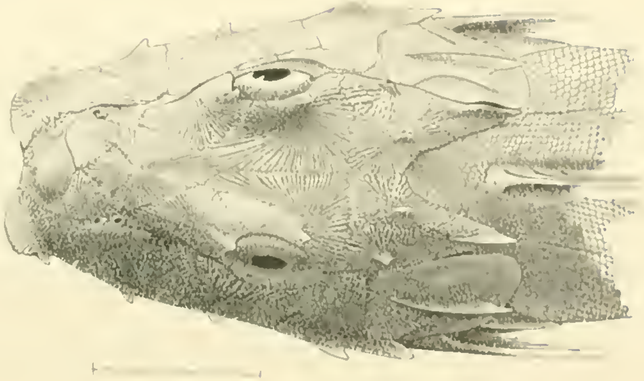
EXPLANATION OF PLATE XXVII.

PAGE

Figs. 50, 50*a*. *Prionotus ruscarius* GILBERT & STARKS. Type specimen; Panama. 165



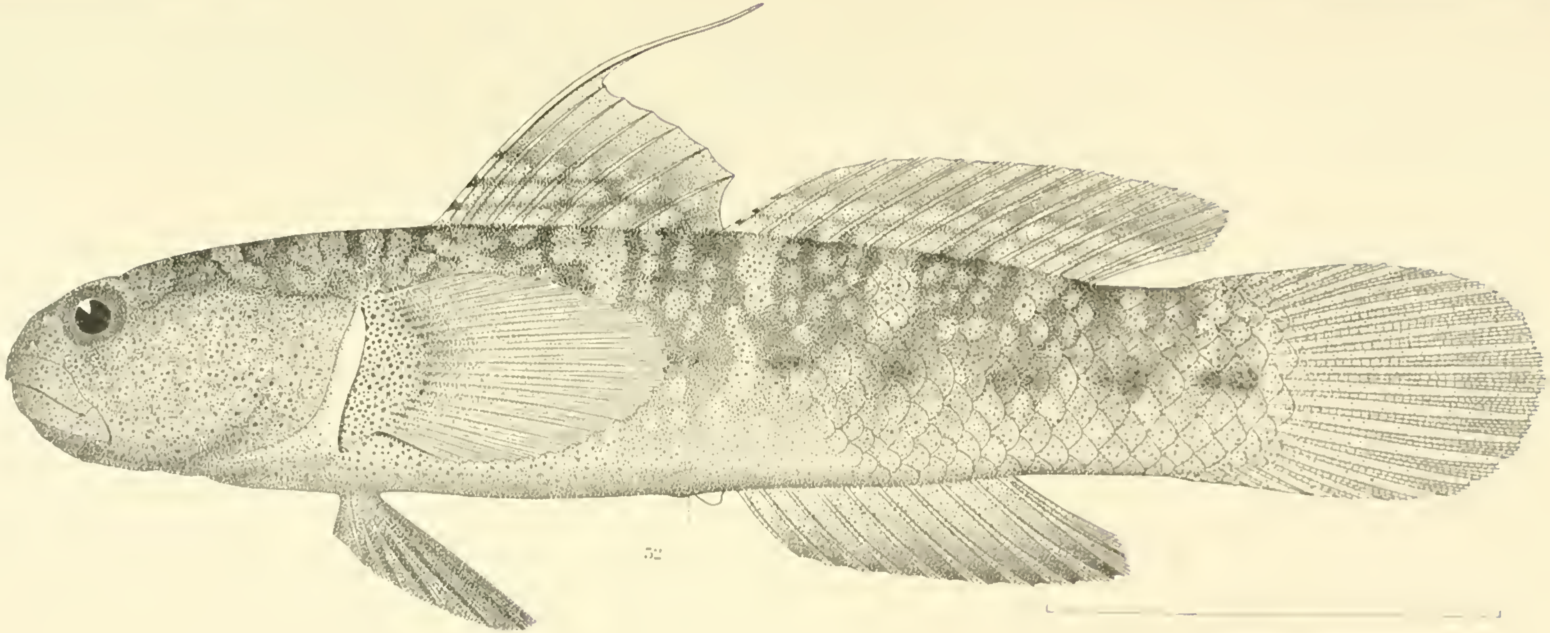
50



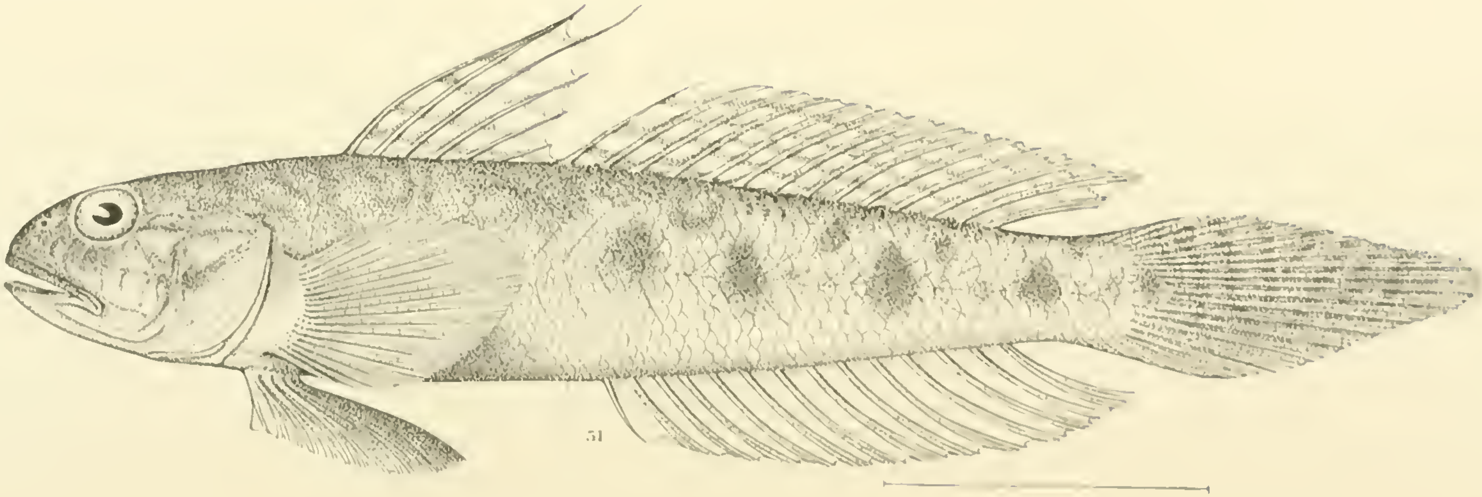
50 a

EXPLANATION OF PLATE XXVIII.

		PAGE
Fig. 51	*Gobionellus microdon* GILBERT. Panama.	171
Fig. 52	*Garmannia paradoxa* GÜNTHER. Panama.	172



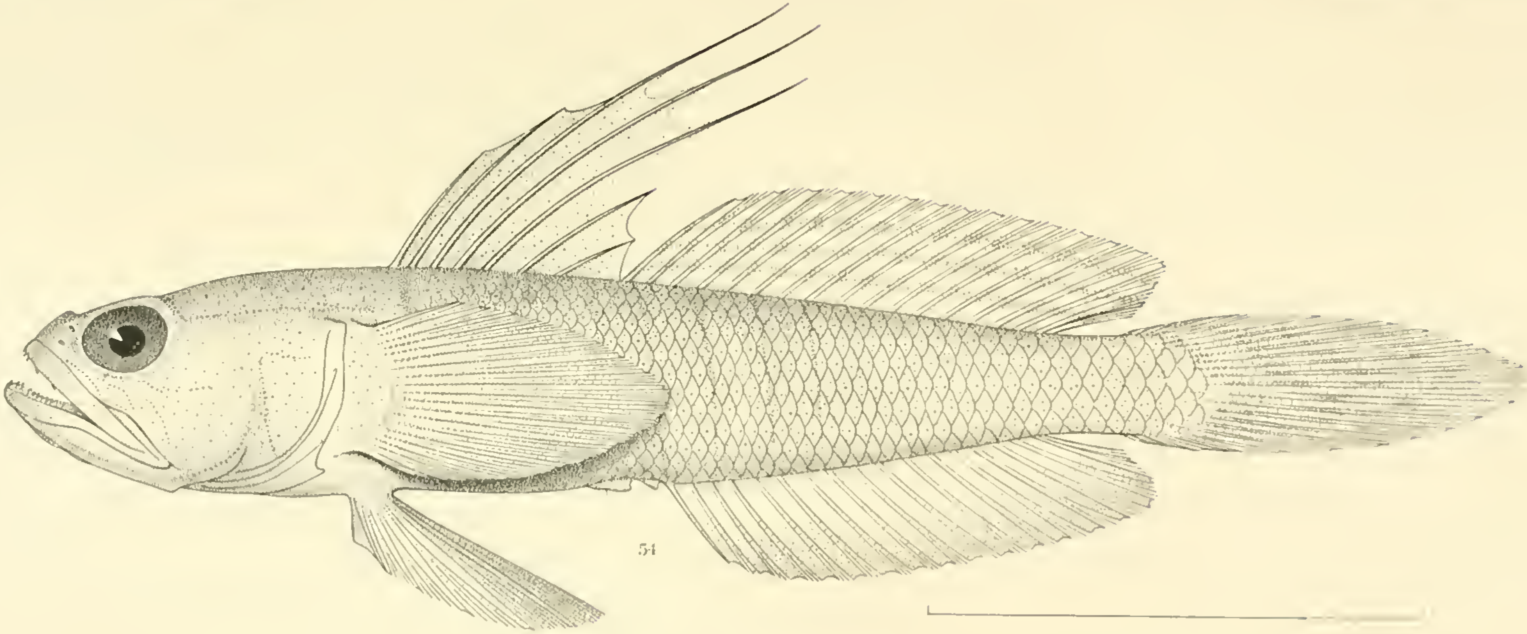
52



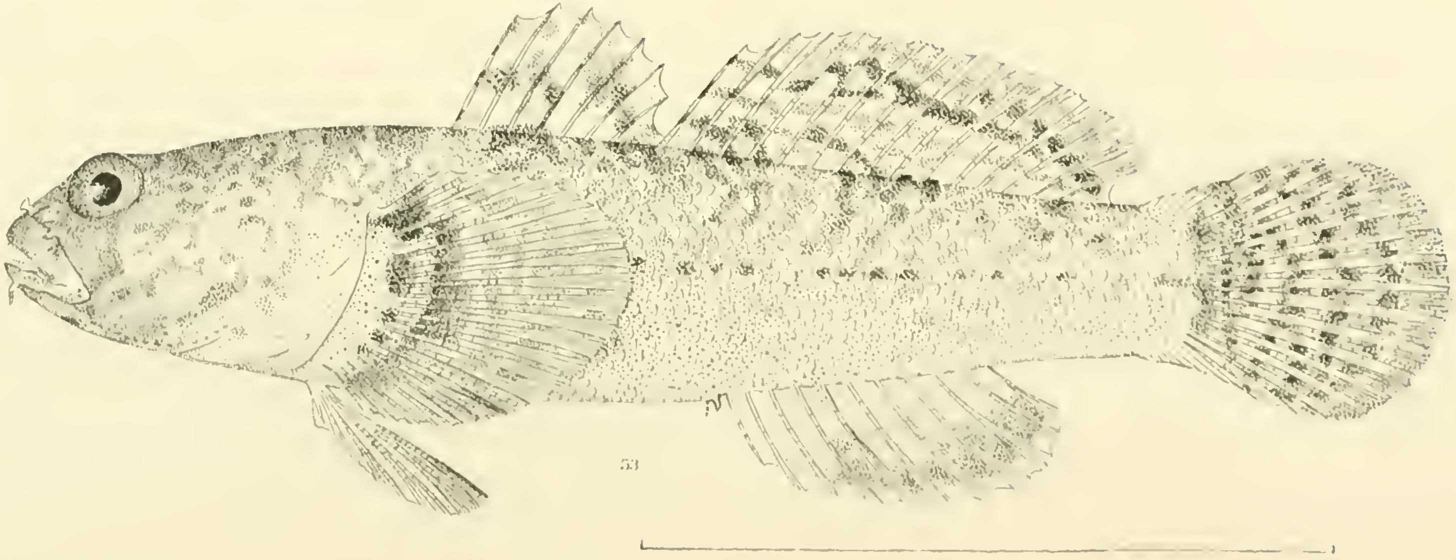
51

EXPLANATION OF PLATE XXIX.

	PAGE
Fig. 53. *Enypnias seminudus* Günther. Panama.	173
Fig. 54. *Microgobius miraflorensis* Gilbert & Starks. Type specimen; Panama.	176



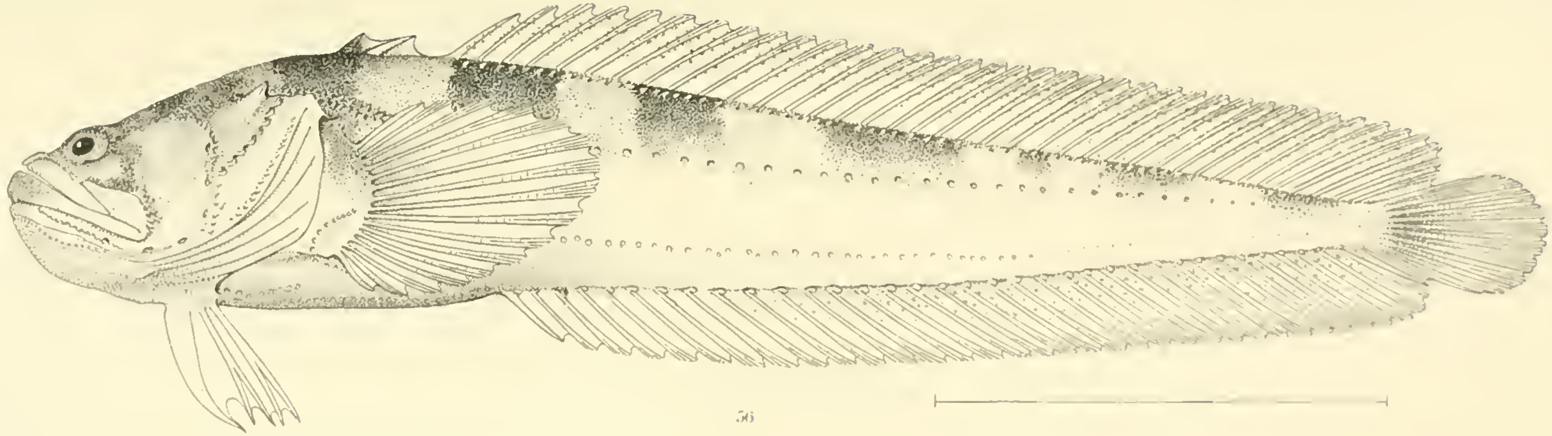
54



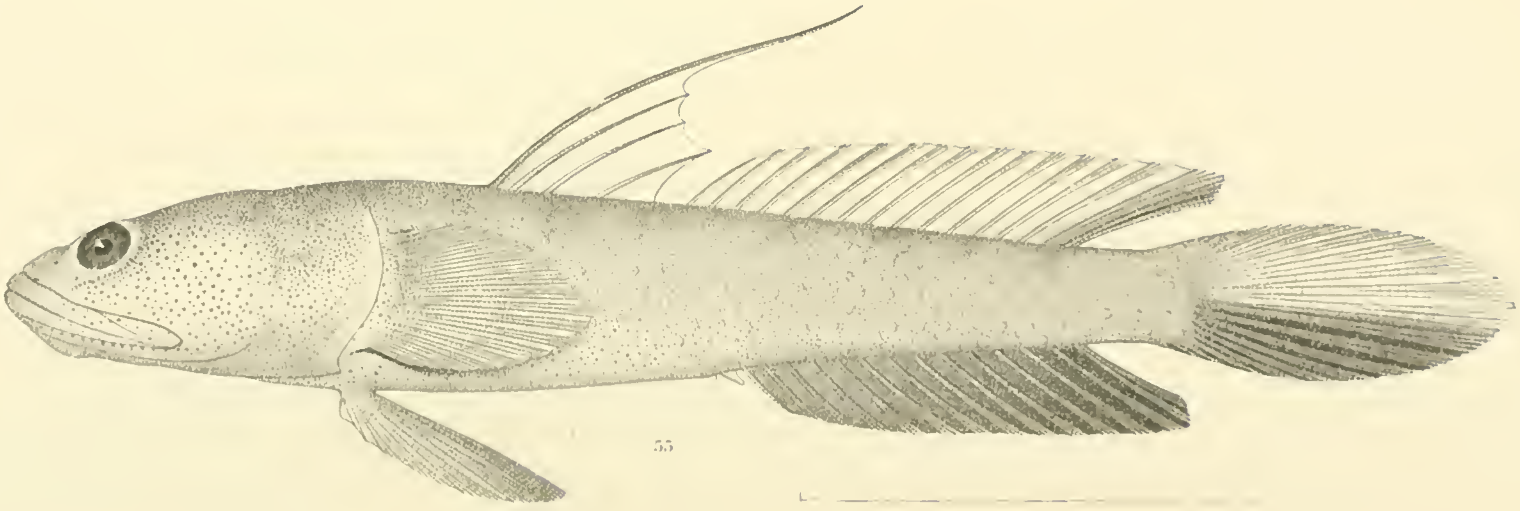
53

EXPLANATION OF PLATE XXX.

		PAGE
Fig. 55.	*Evermannia panamensis* GILBERT & STARKS. Type specimen; Panama.	179
Fig. 56.	*Porichthys greenei* GILBERT & STARKS. Type specimen; Panama.	184



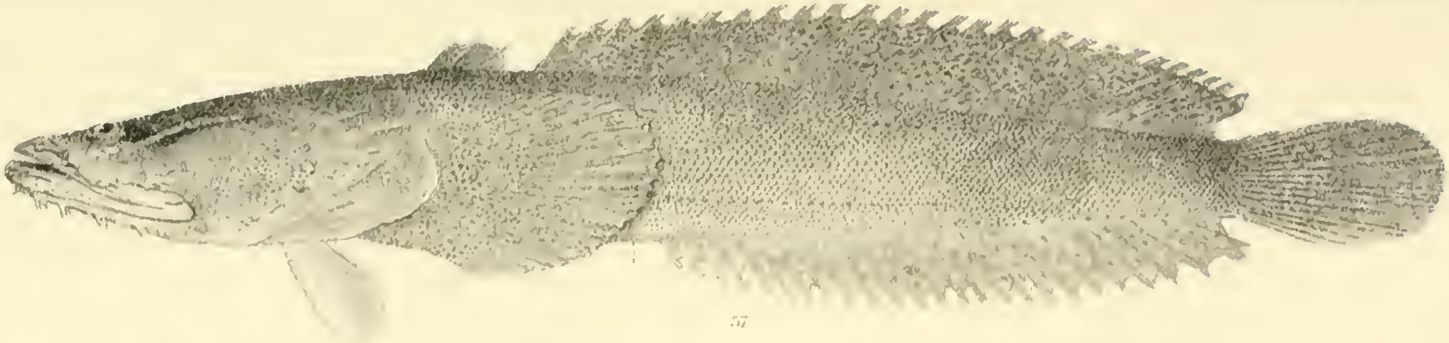
56



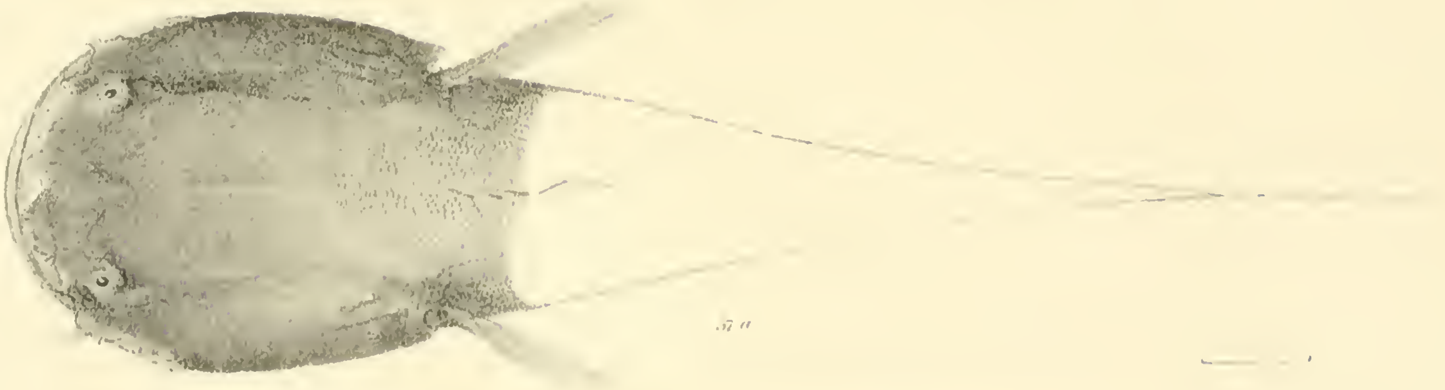
55

EXPLANATION OF PLATE XXXI.

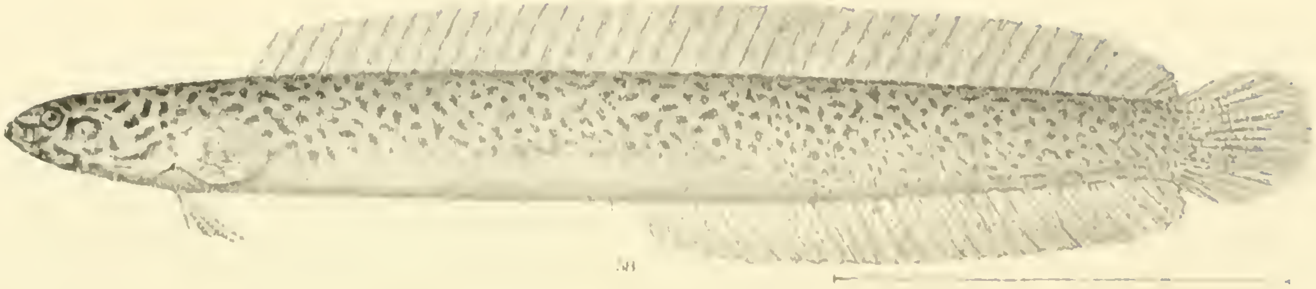
		PAGE
Fig. 57, 57a	*Batrachoides boulengeri* GILBERT & STARKS. Type specimen; Panama.	182
Fig. 58	*Cerdale ionthas* JORDAN & GILBERT. Panama.	196
Fig. 59	*Microdesmus retropinnis* JORDAN & GILBERT. Panama.	195



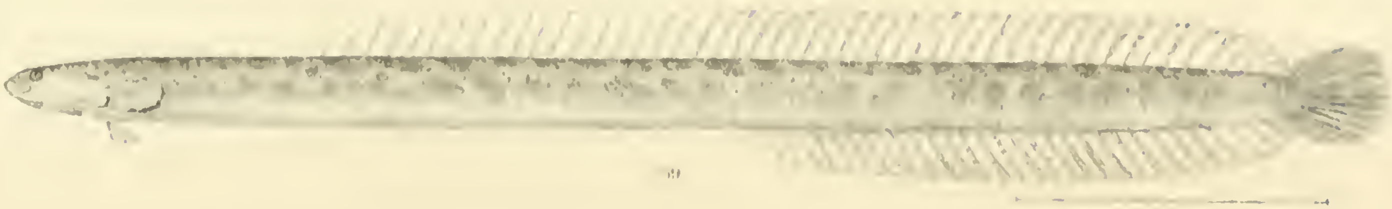
57



57 a



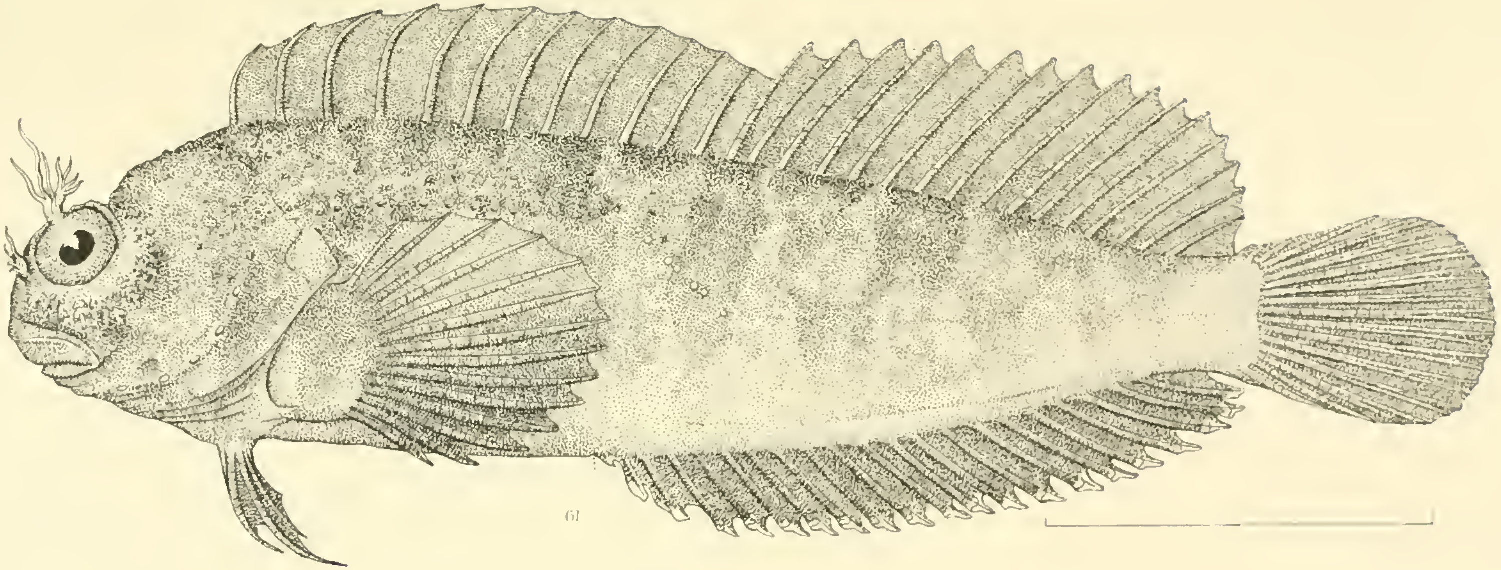
58



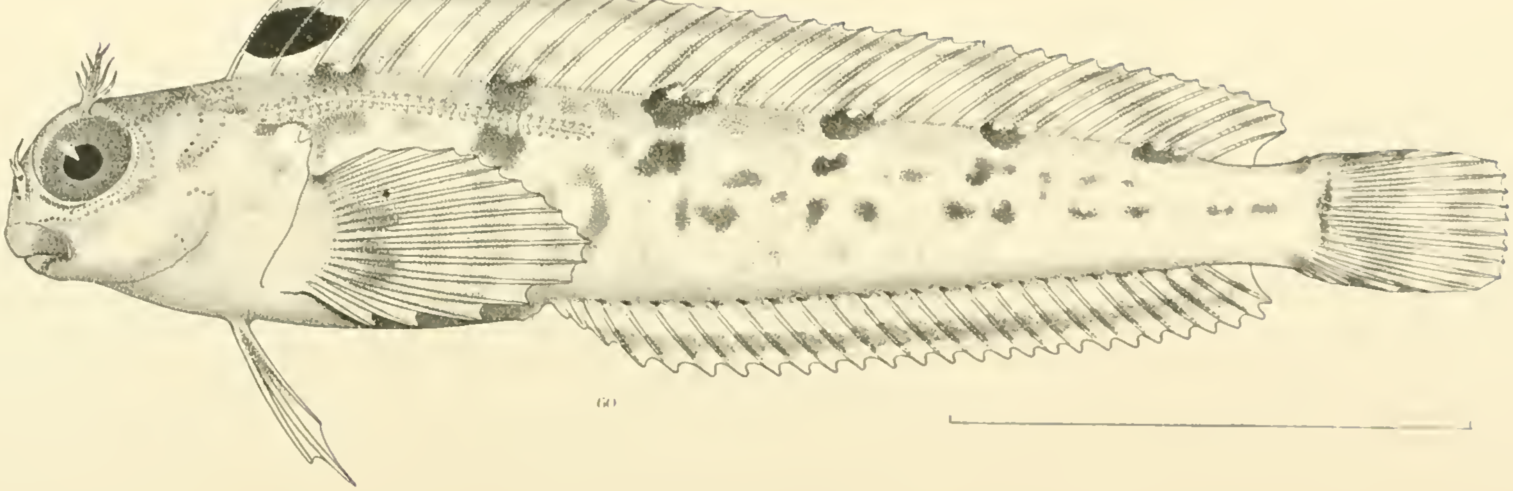
59

EXPLANATION OF PLATE XXXII.

		PAGE
Fig. 60.	*Hypsoblennius piersoni* GILBERT & STARKS. Type specimen; Panama.	191
Fig. 61.	*Homesthes caulopus* GILBERT. Type specimen; Panama.	194



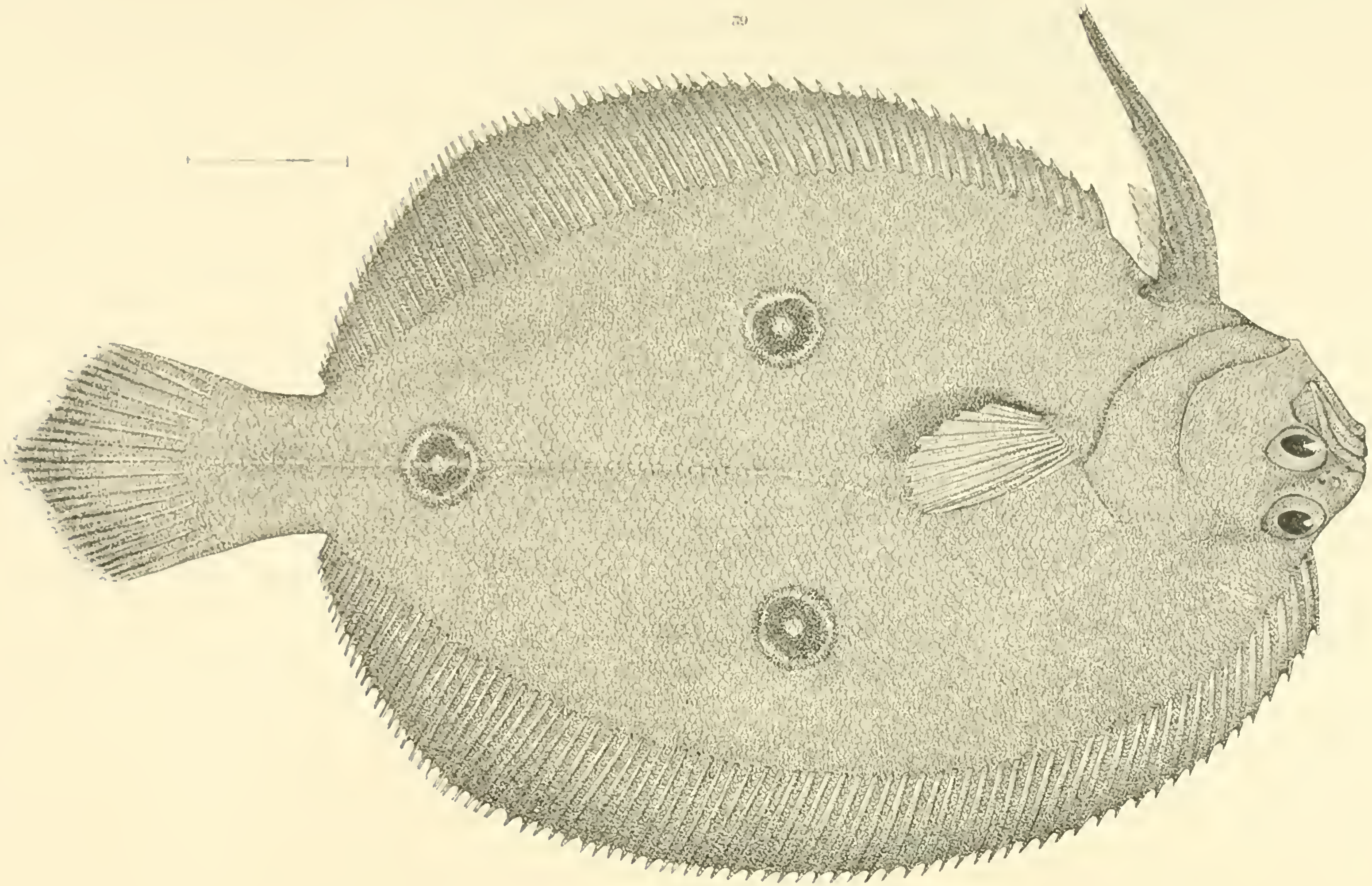
61



60

EXPLANATION OF PLATE XXXIII.

	PAGE
Fig. 62. *Ancylopsetta dendritica* GILBERT. Panama.	199


39

INDEX TO VOLUME IV.

New names in **heavy-faced** type.

ABACURUS, Eleotris 170
Aboma lucretiæ 174, 217
acclivis, Larimus 123, 124, 214
Achirus fonsecensis 201, 203, 218
  klunzingeri 200, 201, 218
  mazatlanus 200, 201
  scutum 202, 218
acutus, Fodiator 55, 210
adspersus, Paralichthys 197
æquidens, Eleotris 169
aerostaticus, Tetraodon 159
æstuarius, Paralichthys 198
æthalorus, Carcharias 9, 11, 207
Aetobatus narinari 18, 207
afer, Alphestes 96, 97
affinis, Fierasfer 197
  Isopisthus 117
agassizii, Xenichthys 104
alalunga, Germo 206
albescens, Remora 206
albirostris, Prionotus 162, 216
albomaculatus, Serranus 97
Albula vulpes 39, 209
Albulidæ 39
albus, Cynoscion 119, 214
Alectis ciliaris 80, 211
Alexurus armiger 170, 216
Alphestes afer 96, 97
  multiguttatus 96, 97, 212
altipinnis, Micropogon 132, 215
altus, Oligoplites 72, 73, 74, 211
aluta, Bairdiella 127
amazonica, Thalassophryne 188
amblyopsis, Eleotris 170
Anableps 51
  dowei 51, 210
  tetrophthalmus 51
analis, Umbrina 133
analogus, Epinephelus 96, 212
  Kyphosus 116
Anchovia compressa 43, 44, 45
  cultrata 44
  curta 42, 209
  delicatissima 44
  ischana 42, 43, 209
  lucida 42, 43, 209
  macrolepidota 47, 209
  miarcha 42, 209
  mundeola 5, 43, 44, 45, 46, 209
  naso 5, 43, 209
  opercularis 42, 209
  panamensis 43, 44, 45, 209
Anchovia **rastralis** 5, 42, 209
  spinifera 46, 209
  starksi 5, 13, 209
ancylodon, Sagenichthys 121
Ancylopsetta dendritica 199, 218
  quadrocellata 199
Angelichthys 151
angusticeps, Spheroides 156
Anisotremus 111
  cæsius 107, 213
  dovii 106, 107, 213
  interruptus 107, 213
  pacifici 106, 107, 213
  surinamensis 107
  tæniatus 108, 213
  virginicus 108
annulatus, Spheroides 156, 157, 158, 159
Antennarius sanguineus 204, 218
  strigatus 204, 218
Apogon atricaudus 89
  atridorsalis 89
  dovii 88, 89, 212
  retrosella 89
approximans, Polydactylus 63, 210
aratus, Lutianus 103, 213
archidium, Elattarchus 125, 214
Archoscion 117
argenteus, Larimus 123, 124, 214
argentiventris, Lutianus 103, 212
argus, Muræna 38
arioides, Bagrus 32, 33
Arius assimilis 23
  melanopus 29
  seemanni 22
armata, Bairdiella 126, 214
armatus, Centropomus 90, 92, 94, 212
armiger, Alexurus 170, 216
Arothron erethizon 159
asperrimus, Myliobatis 5, 19, 207
aspidurus, Urolophus 16, 17, 207
assimilis, Arius 23
asterias, Urolophus 16
Astroscopus 187
Atherinella panamensis 59, 210
Atherinidæ 57
atlanticus, Rupiscartes 191, 217
atramentatus, Symphurus 203, 218
atricaudus, Apogon 89
  Symphurus 204, 218
atridorsalis, Apogon 89
atrilobatus, Chromis 139, 140, 215
atrimanus, Hemicaranx 75, 76, 211

Auchenopterus monophthalmus 189, 217
auctorum, Lobotes 100
auliscus, Siphostoma 57, 210
aureolus, Gerres 114, 115, 213
auritus, Brachydeuterus 111
averruncus, Kathetostoma 181, 217
axillaris, Brachydeuterus 111
Azevia panamensis 200, 218
azureus, Carcharias 5, 11, 12, 207

BAGRES ARIOIDES 32, 33
bahianus, Teuthis 151
Bairdiella 128
    aluta 127
    armata 126, 214
    chrysoleuca 127, 214
    ensifera 126, 214
    icistia 126
balao, Hemirhamphus 53
balearicum, Ophisoma 34
Balistes capistratus 153, 154
    carolinensis 152
    naufragium 152, 153, 216
    polylepis 152, 153, 216
    verres 5, 153, 154, 216
Balistidæ 152
bathymaster, Bregmaceros 197
Batrachoides 185
    boulengeri 5, 181, 182, 217
    pacifici 181, 182, 217
    surinamensis 181, 182, 183
Batrachoididæ 181
Batrachus surinamensis 182
bayanus, Pomadasis 109, 213
Belone truncata 52
birostris, Manta 206
birostratus, Prionotus 165
Blenniidæ 189, 196
Blenniinæ 193
bollmani, Hippoglossina 197, 218
Bollmannia chlamydes, 174, 217
boucardii, Pœcilia 51, 210
boulengeri, Batrachoides 5, 181, 182, 217
boulengeri, Mycteroperca 97, 212
Brachydeuterus 111
    auritus 111
    axillaris 111
    corvinæformis 111
    elongatus 111
    leuciscus 109, 213
    nitidus 109, 111, 213
brachysomus, Calamus 112, 113, 213
branicki, Pomadasis 110, 213
brasiliensis, Hemirhamphus 53, 54
Bregmaceros bathymaster 197
    macclellandi 197, 218
Bregmacerotidæ 197
brevimanus, Gerres 115, 213
brevipinnis, Hypsoblennius 193, 217
    Orthopristis 111, 213
brevis, Tyntlastes 180, 217
Brotulidæ 197
Buccone 118

CABALLUS, Caranx 78, 211
cæsius, Anisotremus 107, 213
Calamus brachysomus 112, 113, 213
    taurinus 112, 113
calamus, Chrysophrys 112
californicus, Galeus 7, 9
californiensis, Eucinostomus 113, 114, 213
callopterus, Cypselurus 55, 210
capistratus, Balistes 153, 154
    Chætodon 149
Carangidæ 70
Caranx caballus 78, 211
    crysos 78
    hippos 77, 211
    latus 78, 79
    lugubris 206
    marginatus 78, 211
    medusicola 78, 79
    vinctus 77, 211
Carcharias 9
    æthalorus 9, 11, 207
    azureus 5, 11, 12, 207
    cerdale 5, 10, 11, 207
    nicaraguensis 12
    velox 5, 9, 207
Carcharinus cerdale 10
    velox 9
carolinensis, Balistes 152
carolinus, Trachinotus 84
Cathorops 34
    gulosus 33, 208
    hypophthalmus 33, 208
caudimacula, Hæmulon 105
caulinaris, Lophiomus 204, 218
caulopus, Homesthes 5, 193, 194, 217
Centropomidæ 89, 206
Centropomus 180
    armatus 90, 92, 94, 212
    ensiferus 92, 94
    grandoculatus 90
    medius 90
    nigrescens 90, 212
    pedimacula 90, 212
    robalito 90, 91, 92, 94, 212
    undecimalis 89, 212
    unionensis 90, 92, 212
    viridis 89
cephalus, Mugil 59, 210
Cerdale 196
    ionthas 196, 218
cerdale, Carcharias 5, 10, 11, 207
cerdale, Carcharinus 10
Cerdalidæ 195, 196, 206
Cetengraulis 42
    edentulus 47, 48
    engymen 5, 48, 209

Cetengraulis mysticetus 47, 48, 209
Chænomugil proboscideus 61, 210
Chætodipterus 148
    faber 147, 148
    zonatus 147, 148, 215
Chætodon capistratus 149
    humeralis 149, 215
    nigrirostris 148, 215
Chætodontidæ 148
chalceus, Orthopristis 110, 213
Cheilodipteridæ 88
chilensis, Sarda 68, 211
chlamydes, Bollmannia 174, 217
Chloroscombrus chrysurus 82
    orqueta 82, 211
Chromis atrilobatus 139, 140, 215
    notatus 140
chrysoleuca, Bairdiella 127, 214
Chrysophrys calamus 112
chrysurus, Chloroscombrus 82
ciliaris, Alectis 80, 211
cinereum, Xystæma 114, 213
cinereus, Microspathodon 144
cirratum, Ginglymostoma 5, 207
Cirrhites rivulatus 139, 215
Cirrhitidæ 139, 206
Citharichthys 4
    gilberti 200, 218
    platophrys 200, 218
    spilopterus 200
Citula dorsalis 79, 211
clarionis, Xesurus 155
clopsydra, Muræna 5, 38, 209
Clevelandia 178
    ios 178
Clupeidæ 39
colias, Scomber 206
colorado, Lutianus 103, 213
compressa, Anchovia 43, 44, 45
concolor, Nexilarius 143, 215
    Scomberomorus 68
Congrellus gilberti 34, 208
    nitens 34, 208
    proriger 34, 208
coniceps, Muræenesox 35, 208
constellatus, Platophrys 199, 218
corneta, Fistularia 5, 56, 57, 210
corvinæformis, Brachydeuterus 111
Corvula macrops 125, 214
crebripunctata, Pteroplatea 18, 207
creolus, Serranus 98
crescentalis, Pomacanthus 150
crestonis, Teuthis 151, 216
crocro, Pomadasis 109
crossotus, Etropus 200, 218
crumenophthalmus, Trachurops 75, 211
crysos, Caranx 78
cultrata, Anchovia 44
culveri, Trachinotus 84, 211
curema, Mugil 60, 210
curta, Anchovia 42, 209
cyclolepis, Microgobius 174, 175
Cyclopsetta querna 200, 218
Cynoscion 4, 117, 118, 120, 125
    albus 119, 214
    othonopterus 119, 214
    phoxocephalus 120, 214
    prædatorius 118, 214
    reticulatus 119, 214
    squamipinnis 118, 214
    stolzmanni 119, 214
cyprinoides, Lophogobius 176
Cypselurus callopterus 55, 210

DACTYLOSCOPIDÆ 181, 206
Dactyloscopus zelotes 181, 217
Dæctor 188
daspilotus, Pisoodonophis 5, 36, 208
Dasyatidæ 15
Dasyatis dipterura 18
    longa 17, 18, 207
dasycephalus, Galeichthys 25, 26, 208
declivifrons, Glyphisodon 143
delalandi, Malacoctenus 189, 217
delicatissima, Anchovia 44
deliciosa, Sciæna 132, 214
dendritica, Ancylopsetta 199, 218
depressa, Fistularia 55, 56, 210
Diapterus dowii 113
Diodon holacanthus 160, 216
    hystrix 161, 206
Diodontidæ 160
Diplectrum 4
    euryplectrum 97, 98, 212
    macropoma 97, 98, 212
    radiale 97, 98, 212
diplotænia, Harpe 144, 215
dipterura, Dasyatis 18
dipus, Microdesmus 195, 218
Discopyge ommata 15, 207
dispilus, Halichœres 146, 215
Dormitator maculatus 169, 216
dormitor, Philypnus 168
dorsalis, Citula 79, 211
    Galeus 7, 207
    Microspathodon 143, 215
    Umbrina 133, 214
dovii, Anisotremus 106, 107, 213
    Apogon 88, 89, 212
    Lycodontis 37, 209
    Opisthopterus 41, 209
dowei, Anableps 51
dowi, Exocœtus 55
    Selenaspis 26, 208
    Thalassophryne 187, 217
dowii, Diapterus 113
    Eucinostomus 113
dubius, Fierasfer 197, 218
dumerili, Polyclemus 134, 135, 215

ECHENEIDIDÆ 180
Echeneis naucrates 180, 217
edentulus, Cetengraulis 47, 48
effulgens, Larimus 5, 123, 214
eigenmanni, Galeichthys 5, 21, 22, 23, 28, 208
elater, Zalieutes 201, 218
Elattarchus archidium 125, 214
elattura, Netuma 29, 208
elegans, Kyphosus 116, 213
Eleotris abacurus 170
    æquidens 169
    amblyopsis 170
    pictus 169, 216
    pisonis 170
elongata, Pœcilia 50, 210
elongatus, Brachydeuterus 111
    Menticirrhus 134, 215
    Symphurus 203, 218
Elopidæ 39
Elops saurus 39, 209
Emblemaria nivipes 194, 217
emblematicus, Microgobius 174, 175, 176, 217
emmelane, Tachysurus 5, 30, 31, 208
Engraulididæ 42
engymen, Cetengraulis 5, 48, 209
Engyophrys sancti-laurentii 199, 218
ensifera, Bairdiella 126, 214
ensiferus, Centropomus 92, 94
ensis, Sphyræna 62, 210
entemedor, Narcine 15, 207
Enypnias 174
    seminudus 173, 217
Ephippidae 147
Epinephelus analogus 96, 212
    labriformis 96, 212
    louti 95
equatorialis, Raja 15, 207
Eques **viola** 5, 128, 138, 215
erate, Lobotes 100
erethizon, Arothron 159
    Tetraodon 160
ericymba, Stellifer 129, 214
Esocidæ 51
Etropus crossotus 200, 218
Eucinostomus californiensis 113, 114, 213
    dowii 113
    harengulus 114
    pseudogula 114
eulepis, Microgobius 176
Eumycterias punctatissimus 160, 216
euryplectrum, Diplectrum 97, 98, 212
Evapristis 111
evermanni, Synodus 49, 209
evermanni, Tachysurus 5, 32, 208
Evermannia 178
    panamensis 5, 178, 179, 217
    zosterura 178, 179, 217
Evoplites 101
Exocœtidæ 55
Exocœtus dowi 55
Exonautes rufipinnis 55, 210

FABER, Chætodipterus 147, 148
falcatus, Trachinotus 84
fasciatus, Genyanemus 134
    Prionodes 98, 212
Felichthys panamensis 20, 207
    pinnimaculatus 20, 207
fernandinus, Squalus 13
Fierasfer affinis 197
    dubius 197, 218
Fierasferidæ 197
fischeri, Solea 201, 202
Fistularia **corneta** 5, 56, 57, 210
    depressa 55, 56, 210
    petimba 56
    serrata 56
    tabacaria 57
Fistulariidæ 55
flaviguttatum, Lythrulon 105, 106, 213
flavilatus, Pomacentrus 142, 215
Fodiator acutus 55, 210
fodiator, Tylosurus 52, 210
fonsecensis, Achirus 201, 203, 218
    Solea 201, 202
forbesi, Orthopristis 111
formosa, Guentheridia 159, 216
formosus, Tetraodon 159
    Tetrodon 158
forsteri, Sphyræna 62
furcifer, Paranthias 98, 212
furthi, Ilisha 40, 209
    Pellona 40
    Stellifer 127, 214
furthii, Hemicaranx 77, 211
    Spheroides 158, 216
    Tachysurus 30, 31, 32, 33, 208

GALEICHTHYS 21
    dasycephalus 25, 26, 208
    eigenmanni 5, 21, 22, 23, 28, 208
    gilberti 22, 23
    guatemalensis 25, 208
    jordani 22, 23, 28, 208
    lentiginosus 20, 207
    longicephalus 25, 26, 208
    peruvianus 21, 207
    platypogon 23
    seemanni 21
    xenauchen 5, 24, 208
Galeidæ 5
Galeocerdo tigrinus 9, 207
Galeus californicus 7, 9
    dorsalis 7, 207
Garmannia 173
    paradoxa 172, 173, 174, 217
gentilis, Hypsoblennius 191, 192, 193
Genyanemus fasciatus 134
Genyoroge 101, 102

- Germo alalunga 206
- Gerres aureolus 114, 115, 213
  - brevimanus 115, 213
  - lineatus 115
  - olisthostomus 115
  - peruvianus 115, 213
  - squamipinnis 114
- Gerridæ 113
- gilberti, Citharichthys 200, 218
  - Congrellus 34, 208
  - Galeichthys 22, 23
  - Hypsoblennius 191, 192, 193, 194
  - Kirtlandia 57, 58, 210
- **gilli**, Pomacentrus 5, 140, 141, 215
- Ginglymostoma cirratum 5, 207
- Ginglymostomidæ 5
- glaucostigma, Rhinobatus 14
- glaucus, Trachinotus 82, 83
- Glyphisodon declivifrons 143
  - saxatilis 143, 215
- Gnathanodon speciosus 79, 211
- Gobiesocidæ 189
- Gobiesox gyrinus 189
  - nudus 189
  - rhodospilus 189, 217
- Gobiidae 167
- Gobionellus microdon 171, 217
  - sagittula 171, 216
- Gobius 173, 174
  - nicholsi 176
  - soporator 171, 216
- goodei, Paralonchurus (Zaclemus) 135
- **goodei**, Polyclemus 5, 135, 215
- goodei, Urolophus 16, 207
- Gramma 98
- Grammistes 98
- grandisquamis, Upeneus 67, 211
- grandoculatus, Centropomus 90
- **greenei**, Porichthys 5, 184, 217
- gronovii, Nomeus 84, 211
- grossidens, Lycengraulis 49
- guatemalensis, Galeichthys 25, 208
- guentheri, Hoplopagrus 101, 212
- **Guentheridia** 158, 159
  - formosa 159, 216
- gulosus, Cathorops 33, 208
  - Microgobius 176
- guttatus, Lutianus 103, 212
  - Petrometopon 95
  - Promicrops 96, 212
- Gymneleotris seminudus 170, 216
- gyrinus, Gobiesox 189

- HÆMULIDÆ 104
- Hæmulon caudimacula 105
  - macrostomum 104
  - mazatlanum 106
  - parra 104, 105
  - scudderi 104, 105, 213
  - steindachneri 105, 213
- Halichœres dispilus 146, 215
  - **macgregori** 5, 145, 215
  - nicholsi 145
  - sellifer 144, 215
- halleri, Urolophus 15, 207
- harengulus, Eucinostomus 114
- harengus, Querimana 61, 62, 210
- Harpe diplotænia 144, 215
- Hemicaranx atrimanus 75, 76, 211
  - furthii 77, 211
  - leucurus 77, 211
  - **zelotes** 5, 76, 211
- Hemirhamphidæ 52
- Hemirhamphus balao 53
  - brasiliensis 53, 54
  - **saltator** 5, 53, 54, 210
- Hexanematichthys 21
  - xenauchen 21
- Hippocampus ingens 57, 210
- Hippoglossina bollmani 197, 218
  - sabanensis 199
- hippos, Caranx 77, 211
- hispidus, Tetraodon 157, 159, 160, 216
- histrio, Scorpæna 161, 216
- Holacanthus 151
  - passer 150, 216
  - strigatus 150
- holacanthus, Diodon 160, 216
- Holocentridæ 64
- Holocentrus suborbitalis 66, 211
- **Homesthes** 193
  - **caulopus** 5, 193, 194, 217
- **hopkinsi**, Xesurus 5, 155, 216
- Hoplopagrus guentheri 101, 212
- horrens, Prionotus 162, 165, 166, 216
- hospes, Mugil 60, 210
- humeralis, Chætodon 149, 215
  - Paralabrax 97, 212
- humile, Pristipoma 109
- humilis, Pristipoma 109
- hypophthalmus, Cathorops 33, 208
- Hypoplectrus lamprurus 97, 212
- Hypoprion 9
- Hyporhamphus pocyi 52
  - roberti 53, 210
  - unifasciatus 52, 210
- Hypsoblennius 193
  - brevipinnis 193, 217
  - gentilis 191, 192, 193
  - gilberti 191, 192, 193, 194
  - ionthas 193
  - **piersoni** 5, 191, 217
  - punctatus 193
  - scrutator 193
  - striatus 192, 193, 217
- hystrix, Diodon 161, 206

- ICISTIA, Bairdiella 126
- Ilisha furthi 40, 209
  - panamensis 40

illecebrosus, Stellifer 5, 128, 129, 138, 214
Ilypnus 178
imiceps, Ophioscion 131, 214
incilis, Mugil 59
indefatigabile, Otophidium 196, 218
inermis, Rabirubia 103, 213
ingens, Hippocampus 57, 210
inornatus, Microlepidotus 111
    Orthopristis 111
insculpta, Netuma 27, 208
insularum, Muræna 38
interruptus, Anisotremus 107, 213
ionthas, Cerdale 196, 218
    Hypsoblennius 193
ios, Clevelandia 178
Isaciella 111
ischana, Anchovia 42, 43, 209
Isopisthus 117, 122
    affinis 117
    parvipinnis 117
    remifer 117, 213

JENKINSI, Synodus 50
jordani, Galeichthys 22, 23, 28, 208
jordani, Lutianus 5, 101, 102, 212
jordani, Neomænis 102

KATHETOSTOMA AVERRUNCUS 181, 217
kennedyi, Trachinotus 84, 211
kessleri, Netuma 26, 208
Kirtlandia 57
    gilberti 57, 58, 210
    pachylepis 57, 210
    vagrans 57
klunzingeri, Achirus 200, 201, 218
kneri, Pristipoma 110
Kyphosidæ 116
Kyphosus analogus 116
    elegans 116, 213

LABRIDÆ 144
labriformis, Epinephelus 96, 212
Lampris luna 206
lamprurus, Hypoplectrus 97, 212
Larimus acclivis 123, 124, 214
    argenteus 123, 124, 214
    effulgens 5, 123, 214
    pacificus 124, 214
lateralis, Philypnus 167, 168, 216
laticlavius, Xesurus 155
latifrons, Syacium 199, 218
latus, Caranx 78, 79
leei, Symphurus 204, 218
lentiginosa, Muræna 39, 209
lentiginosus, Galeichthys 20, 207
Lepophidium prorates 196, 218
Leptocephalidæ 34
lepturus, Trichiurus 70, 211
leuciscus, Brachydeuterus 109, 213
leucurus, Hemicaranx 77, 211
leucorhynchus, Rhinobatus 14, 207
libertate, Opisthonema 40, 209
lineatus, Gerres 115
liropus, Tachysurus 29, 30, 31
lobatus, Spheroides 156
Lobotes 100
    auctorum 100
    erate 100
    pacificus 5, 100, 212
    surinamensis 100, 101
Lobotidæ 100
longa, Dasyatis 17, 18, 207
longicephalus, Galeichthys 25, 26, 208
longurio, Scoliodon 12, 207
Lophiomus caulinaris 204, 218
    setigerus 204
Lophogobius cyprinoides 176
louti, Epinephelus 95
loxias, Prionotus 162, 216
lucasanum, Thalassoma 146, 215
lucida, Anchovia 42, 43, 209
lucretiæ, Aboma 174, 217
lugubris, Caranx 206
luna, Lampris 206
lunulatus, Mustelus 5, 6 7, 8, 207
Lutianidæ 101
Lutianus 101, 102
    aratus 103, 213
    argentiventris 103, 212
    colorado 103, 213
    (Evoplites) viridis 101, 102
    guttatus 103, 213
    jordani 5, 101, 102, 212
    novemfasciatus 102, 212
Lycengraulis grossidens 49
    poeyi 49, 209
Lycodontis dovii 37, 209
    verrilli 37, 209
Lythrulon flaviguttatum 105, 106, 213
    opalescens 105, 106

MACCLELLANDI, Bregmaceros 197, 218
macgregori, Halichœres 5, 145, 215
maclura, Pteroplatea 18
macracanthus, Pomadasis 110, 213
macrocephalus, Muierpes 189, 217
macrolepidota, Anchovia 47, 209
macropoma, Diplectrum 97, 98, 212
macrops, Corvula 125, 214
    Opisthopterus 41, 209
macrostomum, Hæmulon 104
maculatus, Dormitator 169, 216
    Scomberomorus 68, 69
maculicauda, Orthostœchus 106, 213
maculosa, Thalassophryne 188
magdalenæ, Paralichthys 198
Malacoctenus delalandi 189, 217
Manta birostris 206
margaritatus, Porichthys 184, 185, 217
marginatus, Caranx 78, 211

marmoratus, Symbranchus 34, 208
matoides, Teuthis 151
mazatlanum, Hæmulon 106
mazatlanus, Achirus 200, 201
medius, Centropomus 90
  Peprilus 88, 212
medusicola, Caranx 78, 79
melanopus, Arius 29
  Tachysurus 29, 31, 32
melanotis, Muræna 38
Menidia 57
Menticirrhus elongatus 134, 215
  nasus 133, 134, 215
  panamensis 133, 134, 215
  simus 133
miarcha, Anchovia 42, 209
Microdesmus 195, 196
  dipus 195, 218
  retropinnis 195, 218
microdon, Gobionellus 171, 217
Microgobius 177
  cyclolepis 174, 175
  emblematicus 174, 175, 176, 217
  eulepis 176
  gulosus 176
  miraflorensis 5, 176, 217
  signatus 175, 176
  thalassinus 175, 176
Microlepidotus 111
  inornatus 111
Micropogon altipinnis 132, 215
Microspathodon cinereus 144
  dorsalis 143, 215
miraflorensis, Microgobius 5, 176, 217
minor, Stellifer 128
Mnierpes macrocephalus 189, 217
Mola mola 206
mola, Mola 206
monophthalmus, Auchenopterus 189, 217
mordax, Sagenichthys 5, 121, 214
Mugil cephalus 59, 210
  curema 60, 210
  hospes 60, 210
  incilis 59
  thoburni 59, 210
Mugilidæ 59
Mullidæ 67
multiguttatus, Alphestes 96, 97, 212
multiradiatus, Tachysurus 32, 33, 208
mundeola, Anchovia 5, 43, 44, 45, 46, 209
mundeolus, Stolephorus 44
mundus, Oligoplites 70, 72, 73, 74, 211
  Urolophus 16, 17, 207
Muræna argus 38
  clepsydra 5, 38, 209
  insularum 38
  lentiginosa 39, 209
  melanotis 38
  panamensis 37
Murænesocidæ 35
Murænesox coniceps 35, 208
  savanna 35
Murænidæ 37
Mustelus lunulatus 5, 6, 7, 8, 207
Mycteroperca boulengeri 97, 212
Myliobatidæ 18
Myliobatis **asperrimus** 5, 19, 207
Myrichthys tigrinus 35, 208
Myridæ 35
Myripristis occidentalis 64, 65, 210
  pœcilopus 64, 65, 210
Myrophis punctatus 35
  vafer 35, 208
mystes, Scorpæna 161, 216
mysticetus, Cetengraulis 47, 48, 209

Narcine entemedor 15, 207
Narcobatidæ 15
narinari, Aetobatus 18, 207
naso, Anchovia 5, 43, 209
naso, Stolephorus 43
nasus, Menticirrhus 133, 134, 215
naucrates, Echeneis 180, 217
naufragium, Balistes 152, 153, 216
Nebris 122
  occidentalis 122, 214
  zestus 122
nebulosus, Urolophus 15
Nematistiidæ 70, 206
Nematistius pectoralis 70, 211
Neoconger vermiformis 35, 208
Neomænis 101
  jordani 102
Netuma 24
  elattura 29, 208
  insculpta 27, 208
  kessleri 26, 208
  oscula 28, 29, 208
  planiceps 20, 22, 27, 28, 29, 208
  platypogon 27, 28, 208
Nexilarius concolor 143, 215
nicaraguensis, Carcharias 12
nicholsi, Gobius 176
  Halichœres 145
nigrescens, Centropomus 90, 212
nigripinnis, Rypticus 100, 212
nigrirostris, Chætodon 148, 215
nitens, Congrellus 34, 208
nitidus, Brachydeuterus 109, 111, 213
nivipes, Emblemaria 194, 217
Nomeus gronovii 84, 211
notatus, Chromis 140
  Porichthys 184, 185
notospilus, Pseudojulis 145, 146, 215
novemfasciatus, Lutianus 102, 212
nudus, Gobiesox 189

occidentalis, Myripristis 64, 65, 210
  Nebris 122, 214
ocyurus, Sectator 116, 213

Odontognathus panamensis 41, 209
Odontoscion **xanthops** 5, 121, 214
oerstedii, Selene 81, 211
Ogilbia ventralis 197, 218
oglinum, Opisthonema 40
Oligoplites altus 72, 73, 74, 211
    mundus 70, 72, 73, 74, 211
    refulgens 5, 73, 74, 211
    saurus 70, 72, 73, 74, 211
olisthostomus, Gerres 115
ommata, Discopyge 15, 207
opalescens, Lythrulon 105, 106
opercularis, Anchovia 42, 209
    Polydactylus 63, 64, 210
Ophichthus triserialis 37, 208
    zophochir 37, 209
Ophichthyidæ 35
Ophidiidæ 196
Ophioscion imiceps 131, 214
    scierus 131, 214
    simulus 5, 130, 131, 214
    strabo 130, 131, 214
    typicus 129, 131, 214
Ophisoma balearicum 34
Ophisurus xysturus 35
Opisthognathidæ 180
Opisthognathus punctatum 180, 217
Opisthonema libertate 40, 209
    oglinum 40
Opisthopterus dovii 41, 209
    macrops 41, 209
orqueta, Chloroscombrus 82, 211
Orthopristis 111
    brevipinnis 111, 213
    chalceus 110, 213
    forbesi 111
    inornatus 111
Orthostœchus maculicauda 106, 213
oscitans, Stellifer 127
oscula, Netuma 28, 29, 208
osculus, Tachisurus 29
othonopterus, Cynoscion 119, 214
Otophidium indefatigabile 196, 218
ovale, Syacium 199, 218

PACHYLEPIS, Kirtlandia 57, 210
pacifici, Anisotremus 106, 107, 213
    Batrachoides 181, 182, 217
pacificus, Larimus 124, 214
pacificus, Lobotes 5, 100, 212
pacificus, Tylosurus 52, 210
paloma, Trachinotus 84, 211
palometa, Peprilus 85, 212
panamensis, Anchovia 43, 44, 45, 209
    Atherinella 59, 210
    Azevia 200, 218
panamensis, Evermannia 5, 178, 179, 217
panamensis, Felichthys 20, 207
    Ilisha 40
    Menticirrhus 133, 134, 215
panamensis, Muræna 37
    Odontognathus 41, 209
    Parapsettus 148, 215
    Pellona 40
    Petrometopon 95, 212
    Pomadasis 109, 213
    Rabula 37, 209
    Solea 201, 202
pannosa, Scorpæna 161, 216
paradoxa, Garmannia 172, 173, 174, 217
Paralabrax humeralis 97, 212
Paralichthys adspersus 197
    æstuarius 198
    magdalenæ 198
    sinaloæ 197, 198
    woolmanni 197, 198, 218
Paralonchurus 136, 137
    petersi 135, 136, 215
    (Zaclemus) goodei 135
Paranthias furcifer 98, 212
Parapsettus panamensis 148, 215
parra, Hæmulon 104, 105
parvipinnis, Isopisthus 117
passer, Holacanthus 150, 216
pectoralis, Nematistius 70, 211
pedimacula, Centropomus 90, 212
Pellona furthi 40
    panamensis 40
Peprilus medius 88, 212
    palometa 85, 212
    snyderi 5, 87, 212
perrico, Pseudoscarus 146, 215
perspicillaris, Tetraodon 159
peruanus, Polyclemus 135
peruvianus, Galeichthys 21, 207
    Gerres 115, 213
petersi, Paralonchurus 135, 136, 215
petimba, Fistularia 56
Petrometopon guttatus 95
    panamensis 95, 212
Philypnus 168
    dormitor 168
    lateralis 167, 168, 216
phoxocephalus, Cynoscion 120, 214
picturatus, Trachurus 206
pictus, Eleotris 169, 216
piersoni, Hypsoblennius 5, 191, 217
pinnimaculatus, Felichthys 20, 207
pisonis, Eleotris 170
Pisoodonophis **daspilotus** 5, 36, 208
planiceps, Netuma 20, 22, 27, 28, 29, 208
platophrys, Citharichthys 200, 218
Platophrys constellatus 199, 218
Platypodon 11
platypogon, Netuma 23, 27, 28, 208
Pleuronectidæ 197
plumieri, Scorpæna 161
Pœcilia boucardii 51, 210
    elongata 50, 210
Pœciliidæ 50

pœcilopus, Myripristis 64, 65, 210
poeyi, Hyporhamphus 52
    Lycengraulis 49, 209
politus, Spheroides 157, 158
Polyclemus 135
    dumerili 134, 135, 215
    goodei 5, 135, 215
    peruanus 135
    rathbuni 135, 215
Polydactylus approximans 63, 210
    opercularis 63, 64, 210
polylepis, Balistes 152, 153, 216
Polynemidæ 63
Pomacanthus crescentalis 150
    zonipectus 150, 215
Pomacentridæ 139
Pomacentrus flavilatus 142, 215
    gilli 5, 140, 141, 215
    rectifrænum 140, 141, 142, 215
Pomadasis 111
    bayanus 109, 213
    branicki 110, 213
    crocro 109
    macracanthus 110, 213
    panamensis 109, 213
Pomadasys 100
Porichthys **greenei** 5, 184, 217
    margaritatus 184, 185, 217
    notatus 184, 185
prædatorius, Cynoscion 118, 214
Priacanthidæ 101
Priacanthus serrula 212
Prionodes fasciatus 98, 212
Prionotus 4
    albirostris 162, 216
    birostratus 165
    horrens 162, 165, 166, 216
    loxias 162, 216
    quiescens 162, 216
    ruscarius 5, 162, 163, 165, 216
    tribulus 162, 165
    xenisma 162, 216
Pristidæ 14
Pristipoma humile 109
    humilis 109
    kneri 110
Pristis zephyreus 14, 207
proboscideus, Chænomugil 61, 210
Promicrops guttatus 96, 212
prorates, Lepophidium 196, 218
proriger, Congrellus 34, 208
pseudogula, Eucinostomus 114
Pseudojulis notospilus 145, 146, 215
Pseudopriacanthus serrula 101
Pseudoscarus perrico 146, 215
Pteroplatea crebripunctata 18, 207
    maclura 18
    rava 18
punctatissimus, Eumycterias 160, 216
punctatum, Opisthognathus 180, 217
punctatus, Hypsoblennius 193
    Myrophis 35
    Xesurus 155

QUADROCELLATA, Ancylopsetta 199
Querimana harengus 61, 62, 210
querna, Cyclopsetta 200, 218
quiescens, Prionotus 162, 216

RABIRUBIA INERMIS 103, 213
Rabula panamensis 37, 209
radiale, Diplectrum 97, 98, 212
Raja equatorialis 15, 207
Rajidæ 15
Ramularia 199
rastralis, Anchovia 5, 42, 209
rastralis, Stolephorus 42
rathbuni, Polyclemus 135, 215
rava, Pteroplatea 18
rectifrænum, Pomacentrus 140, 141, 142, 215
refulgens, Oligoplites 5, 73, 74, 211
remifer, Isopisthus 117, 213
Remora albescens 206
    remora 180, 217
remora, Remora 180, 217
reticulata, Thalassophryne 186, 188, 217
reticulatus, Cynoscion 119, 214
retropinnis, Microdesmus 195, 218
retrosella, Apogon 89
Rhegma 98
    thaumasium 5, 99, 212
Rhegmatinæ 99
Rhinobatidæ 14
Rhinobatus glaucostigma 14
    leucorhynchus 14, 207
rhodopus, Trachinotus 82, 83, 211
rhodospilus, Gobiesox 189, 217
rivulatus, Cirrhites 139, 215
robalito, Centropomus 90, 91, 92, 94, 212
roberti, Hyporhamphus 53, 210
rogersi, Urolophus 16
rubropunctatus, Scartichthys 194, 217
rutipinnis, Exonautes 55, 210
Rupiscartes atlanticus 194, 217
ruscarius, Prionotus 5, 162, 163, 165, 216
russula, Scorpæna 161, 216
Rypticinæ 98, 99
Rypticus 98
    nigripinnis 100, 212

SABANENSIS, Hippoglossina 199
Sagenichthys 122, 137
    ancylodon 121
    mordax 5, 121, 214
sagittula, Gobionellus 171, 216
saltator, Hemirhamphus 5, 53, 54, 210
sancti-laurentii, Engyophrys 199, 218
sanguineus, Antennarius 204, 218
Sarda chilensis 68, 211

Sardinella stolifera 39, 209
saurus, Elops 39, 209
    Oligoplites 70, 72, 73, 74, 211
savanna, Muraenesox 35
saxatilis, Glyphisodon 143, 215
scapularis, Tylosurus 51, 210
Scaridæ 146
Scartichthys rubropunctatus 194, 217
Scarus 4
Sciadeichthys troscheli 26, 208
Sciæna deliciosa 132, 214
Sciænidæ 117
sciurus, Ophioscion 131, 214
scituliceps, Synodus 50, 209
Scoliodon longurio 12, 207
Scomber colias 206
Scomberomorus concolor 68
    maculatus 68, 69
    sierra 68, 69, 211
Scombridæ 68
Scorpæna histrio 161, 216
    mystes 161, 216
    pannosa 161, 216
    plumieri 161
    russula 161, 216
Scorpænidæ 161
scrutator, Hypsoblennius 193
scudderi, Hæmulon 104, 105, 213
scutum, Achirus 202, 218
Sectator ocyurus 116, 213
seemanni, Arius 22
    Galeichthys 21
Selenaspis dowi 26, 208
Selene œrstedii 81, 211
    vomer 81, 82, 211
sellifer, Halichœres 144, 215
seminudus, Enypnias 173, 217
    Gymneleotris 170, 216
Serranidæ 95
Serranus albomaculatus 97
    creolus 98
serrata, Fistularia 56
serrula, Pseudopriacanthus 101, 212
setigerus, Lophiomus 204
setipinnis, Vomer 80, 211
setosus, Tetraodon 159
sierra, Scomberomorus 68, 69, 211
Sigmurus vermicularis 132, 214
signatus, Microgobius 175, 176
Siluridæ 20
simulus, Ophioscion 5, 130, 131, 214
simus, Menticirrhus 133
sinaloæ, Paralichthys 197, 198
Siphostoma auliscus 57, 210
snyderi, Peprilus 5, 87, 212
Solea fischeri 201, 202
    fonsecensis 201, 202
    panamensis 201, 202
Soleidæ 200
soporator, Gobius 171, 216
Sparidæ 112
speciosus, Gnathanodon 79, 211
Spheroides 158, 159
    angusticeps 156, 216
    annulatus 156, 157, 158, 159, 216
    furthii 158, 216
    lobatus 156, 216
    politus 157, 158
    testudineus 156, 216
Sphyræna ensis 62, 210
    forsteri 62
Sphyrænidæ 62
Sphyrna tiburo 13, 207
    tudes 13, 207
    zygæna 13, 207
Sphyrnidæ 13
spilopterus, Citharichthys 200
spinifera, Anchovia 46, 209
spixii, Vomer 80
Squalidæ 13
Squalus 13
    fernandinus 13
    sucklii 13, 207
squamipinnis, Cynoscion 118, 214
    Gerres 114
starksi, Anchovia 5, 43, 209
starksi, Stolephorus 43
steindachneri, Hæmulon 105, 213
steindachneri, Tachysurus 5, 29, 30, 208
Stellifer 128
    ericymba 129, 214
    furthi 127, 214
    illecebrosus 5, 128, 129, 138, 214
    minor 128
    oscitans 127, 214
    zestocarus 5, 129, 214
Stolephorus mundeolus 44
    naso 43
    rastralis 42
    starksi 43
stolifera, Sardinella 39, 209
stolzmanni, Cynoscion 119, 214
    Tylosurus 52, 210
strabo, Ophioscion 130, 131, 214
striatus, Hypsoblennius 192, 193, 217
strigatus, Antennarius 204, 218
    Holacanthus 150
suborbitalis, Holocentrus 66, 211
sucklii, Squalus 13, 207
surinamensis, Anisotremus 107
    Batrachoides 181, 182, 183
    Batrachus 182
    Lobotes 100, 101
Syacium latifrons 199, 218
    ovale 199, 218
Symbranchidæ 34
Symbranchus marmoratus 34, 208
Symphurus 4
    atramentatus 203, 218
    atricaudus 204, 218

Symphurus, elongatus 203, 218
  leei 204, 218
Syngnathidæ 57
Synodontidæ 49
Synodus evermanni 49, 209
  jenkinsi 50
  scituliceps 50, 209

TABACARIA, Fistularia 57
Tachisurus osculus 29
Tachysurus 29, 30, 31, 34
  emmolane 5, 30, 31, 208
  evermanni 5, 32, 208
  furthii 30, 31, 32, 33, 208
  liropus 29, 30, 31
  melanopus 29, 31, 32
  multiradiatus 32, 33, 208
  steindachneri 5, 29, 30, 208
tæniatus, Anisotremus 108, 213
taurinus, Calamus 112, 113
testudineus, Spheroides 156
Tetraodon 159
  aerostaticus 159
  erethizon 160
  formosus 159
  hispidus 157, 159, 160, 216
  perspicillaris 159
  setosus 159
Tetraodontidæ 156, 158
Tetrodon formosus 158
tetrophthalmus, Anableps 51
Teuthididæ 151
Teuthis bahianus 151
  crestonis 151, 216
  matoides 151
thalassinus, Microgobius 175, 176
Thalassoma lucasanum 146, 215
Thalassophryne 188
  amazonica 188
  dowi 187, 217
  maculosa 188
  reticulata 186, 188, 217
thaumasium, Rhegma 5, 99, 212
thoburni, Mugil 59, 210
Thunnus thynnus 206
thynnus, Thunnus 206
Thyrina 57
tiburo, Sphyrna 13, 207
tigrinus, Galeocerdo 9, 207
  Myrichthys 35, 208
Trachinotus carolinus 84
  culveri 84, 211
  falcatus 84
  glaucus 82, 83
  kennedyi 84, 211
  paloma 84, 211
  rhodopus 82, 83, 211
Trachurops crumenophthalmus 75, 211
Trachurus picturatus 206
  trachurus 206
trachurus, Trachurus 206
tribulus, Prionotus 162, 165
Trichiuridæ 70
Trichiurus lepturus 70, 211
Triglidæ 162
triserialis, Ophichthus 37, 208
troscheli, Sciadeichthys 26, 208
truncata, Belone 52
tudes, Sphyrna 13, 207
Tylosurus 4
  fodiator 52, 210
  pacificus 52, 210
  scapularis 51, 210
  stolzmanni 52, 210
Tyntlastes brevis 180, 217
typicus, Ophioscion 129, 131, 214

UMBRIFER, Urolophus 15
Umbrina analis 133
  dorsalis 133, 215
  xanti 133, 215
undecimalis, Centropomus 89, 212
unifasciatus, Hyporhamphus 52, 210
unionensis, Centropomus 90, 92, 212
Upeneus grandisquamis 67, 211
Uranoscopidæ 181
Urolophus aspidurus 16, 17, 207
  asterias 16
  goodei 16, 207
  halleri 15, 207
  mundus 16, 17, 207
  nebulosus 15
  rogersi 16
  umbrifer 15

VAFER, Myrophis 35, 208
vagrans, Kirtlandia 57
velox, Carcharias 5, 9
velox, Carcharinus 9
ventralis, Ogilbia 197, 218
vermicularis, Sigmurus 132, 214
vermiformis, Neoconger 35, 208
verres, Balistes 5, 153, 154, 216
verrilli, Lycodontis 37, 209
vinctus, Caranx 77, 211
viola, Eques 5, 128, 138, 215
virginicus, Anisotremus 108
viridis, Centropomus 89
  Lutianus (Evoplites) 101, 102
Vomer setipinnis 80, 211
  spixii 80
vomer, Selene 81, 82, 211
vulpes, Albula 39, 209

WOOLMANNI, Paralichthys 197, 198, 218

XANTHOPS, Odontoscion 5, 124, 214
xanti, Umbrina 133, 215
  Xenichthys 103, 213
xenauchen, Galeichthys 5, 24, 208

xenauchen, Hexanematichthys 21
Xenichthys agassizii 104
    xanti 103, 213
    xenops 103
xenisma, Prionotus 162, 216
xenops, Xenichthys 103
Xesurus clarionis 155
    hopkinsi 5, 155, 216
    laticlavius 155
    punctatus 155
Xystæma cinereum 114, 213
xyster, Zapteryx 15, 207
xysturus, Ophisurus 35
ZALIEUTES ELATER 204, 218
Zalypnus 175
Zapteryx xyster 15, 207
zelotes, Hemicaranx 5, 76, 211
zelotes, Dactyloscopus 181, 217
zephyreus, Pristis 14, 207
zestocarus, Stellifer 5, 129, 214
zestus, Nebris 122
zonatus, Chætodipterus 147, 148, 215
zonipectus, Pomacanthus 150, 215
zophochir, Ophichthus 37, 209
zosterura, Evermannia 178, 179, 217
zygæna, Sphyrna 13, 207

ERRATA.

Page 5, 21st line, for "*Hemiramphus*" read *Hemirhamphus*.
Page 21, 10th line from bottom, for "*Fig. 7*" read *Fig. 8*.
Page 22, 17th line, for "*G. planiceps*" read *Netuma planiceps*.
Page 23, 2nd line, for "*G. platypogon*" read *Netuma platypogon*.
Page 24, 2nd line, for "*Fig. 8*" read *Fig. 7*.
Page 43, 7th line from bottom, for "*A. ischanus*" read *A. ischana*.
Page 74, 12th line from bottom, after "Jordan and Starks," insert Plate XII, Fig. 21.
Page 75, 14th line from bottom, for "*crumenopthalmus*" read *crumenophthalmus*.
Page 111, 20th line, for "*elongatus*" read *leuciscus*.
Page 128, 6th line, for "*Stelliferus*" read *Stellifer*.
Page 133, 21st and 22nd lines, for "*Menticirrus*" read *Menticirrhus*.
Page 134, 1st and 26th lines, for "*Menticirrus*" read *Menticirrhus*.
Page 135, 17th line, for "*Polyclemus fasciatus*" read *Polyclemus dumerili*.
Page 159, 4th line, for "*erethizon*" read *hispidus*.

Remove parentheses from names of authorities for the following species: *Mustelus lunulatus* (page 5), *Pristis zephyreus*, *Rhinobatus leucorhynchus* (page 14), *Zapteryx xyster*, *Raja equatorialis*, *Narcine entemedor*, *Discopyge ommata*, *Urolophus halleri* (page 15), *Urolophus goodei*, *Urolophus aspidurus* (page 16), *Pteroplatea crebripunctata* (page 18), *Myliobatis asperrimus* (page 19), *Galeichthys peruvianus* (page 21).

Enclose in parentheses names of authorities for: *Galeus dorsalis* (page 7), *Scoliodon longurio* (page 12).

(Continued from Second Page of Cover.)

17. Phycological Memoirs. By De Alton Saunders. pp. 22. 21 *plates.*

18. The Phosphorescent Organs in the Toadfish Porichthys notatus Girard. By Charles Wilson Greene. pp. 24. 3 *plates.*

19. New Mallophaga, III. Comprising Mallophaga from Birds of Panama, Baja California and Alaska. By Vernon L. Kellogg. **Mallophaga from Birds of California.** By Vernon L. Kellogg and Bertha L. Chapman. **The Anatomy of the Mallophaga.** By Robert E. Snodgrass. pp. 229. 17 *plates.*

20. The Nature of the Association of Alga and Fungus in Lichens. By George James Peirce. pp. 36. 1 *plate.*

21. Studies on the Flower and Embryo of Sparganium. By Douglas Houghton Campbell. pp. 38. 3 *plates.*

22. The Development and Phylogeny of Placenticeras. By James Perrin Smith. pp. 60. 5 *plates.*

23. Studies on the Coast Redwood, Sequoia sempervirens Endl. By George James Peirce. pp. 24. 1 *plate.*

24. Description of Two New Genera of Fishes (Ereunias and Draciscus) from Japan. By David Starr Jordan and John Otterbein Snyder. **Description of Three New Species of Fishes from Japan.** By David Starr Jordan and Edwin Chapin Starks. pp. 10. 4 *plates.*

25. Notes on Coccidæ (Scale Insects): Notes on Cerococcus. By Rose W. Patterson. **New and Little Known California Coccidæ.** By S. I. Kuwana. **The Redwood Mealy Bug** ***(Dactylopius sequoiæ sp. nov.).*** By George A. Coleman. **The San Jose Scale in Japan.** By S. I. Kuwana. pp. 50. 6 *plates.*

26. Studies on Ciliate Infusoria. By N. M. Stevens. pp. 44. 6 *plates.*

27. Coccidæ (Scale Insects) of Japan. By Shinkai Inokichi Kuwana. pp. 56. 7 *plates.*

28. The Anatomy of Epidella squamula, sp. nov. By Harold Heath. pp. 30. 2 *plates.*

29. The Root-tubercles of Bur Clover (Medicago denticulata Willd.) and of Some Other Leguminous Plants. By George James Peirce. pp. 34. 1 *plate.*

30. The Net-Winged Midges (Blepharoceridæ) of North America. By Vernon L. Kellogg. pp. 50. 5 *plates.*

31. The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California. By Ralph Arnold. pp. 420. 37 *plates.*

32. The Fishes of Panama Bay. By Charles H. Gilbert and Edwin C. Starks. pp. 304. 33 *plates.*

Address,

CHARLES H. GILBERT,

Stanford University, California.

3 5185 00293 3594